RAILROAD

VALUATION AND RATES

BY

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FOREWORD

This book is intended primarily as a treatise on the Principles of Rates and their relation to Valuation and Rate Regulation. In view of this fact, the reader is entitled to an explanation of why the first four chapters are devoted to what at first sight seem unrelated subjects.

No discussion in regard to the proper basis for rate-making can last very long without reference to Capitalization and Valuation. The discussion on capitalization finally turns on the abuses practiced in the construction and promotion of railroads. Promotion and construction are most intimately connected with capitalization—in fact, very much more so than capitalization is with rate-making.

There is seemingly some confusion on the part of some authors and publicists in regard to the facts concerning and the conditions surrounding the promotion and construction of our railroads and the relation which such facts and conditions have to capitalization. Many of us have come to accept these widely published interpretation of facts for the facts themselves, generally because we do not take the time to make the investigation necessary to determine their accuracy.

The general impression one gets from much of the discussion and criticism of the railroad situation

is, that the original promoters of railroads have invariably reaped enormous, and hence unearned, rewards; that the construction of the roads has been attended invariably by fraud and that the most of the original capitalization, and all of the increases in the last twenty years, represent only the "nerve" of the financier in injecting water into railroad securities.

There are undoubtedly many well-authenticated instances in which the conditions recited are true, but we are inclined to judge a whole **class** of individuals or **all** members engaged in some line of business or industry by the actions of only a few of them, forgetting that these are not representative of the mass.

We have seen, in some instances, that editors of important publications and professors of our universities, who lead public opinion, have said or done very foolish things, yet we regard these professions with respect and believe that as a class they are intelligent and well-informed men. Ministers and priests have broken their vows; lawyers have been unfaithful to the interests of their clients; doctors have violated confidence reposed in them; and yet as a class we regard the minister, priest, lawyer and doctor more highly than we do other classes of men, and because as a class they are worthy of our regard and confidence, irrespective of what individual members of their professions may have done. Our judgment is based on the normal and usual things—not on the extraordinary and abnormal.

For these reasons it has appeared to the author that a historical statement of the facts regarding these matters, in so far as they have a bearing on the main subject, would assist in obtaining a better understanding of them and their relation to our subject. This statement will be brief and confined only

to those prominent features of interest in the connection named.

No one man can, from his own experience, speak with final authority on all of the many sides of railroad affairs. If he is to write for the purpose of informing those unfamiliar with the detail of railroad work and its problems, he should, however, have been in actual contact with some of them, in order that he have a basis of practical experience on which to form his judgment as to what are essential facts and their relation to each other.

All of us, even when we attempt to be thoroughly honest with ourselves and with others, are unconsciously biased by our environment and service. The reader of a book which discusses subjects on which there is such diversity of opinion as exists at the present time as to railroad matters, is entitled to know the bias of any one who assumes to inform him.

The writer has had some thirty years experience in connection with the promotion, construction, reconstruction, operation and valuation of railroads, as an engineer in the service of railroad corporations; of banking institutions, financing or investigating their operation, organization or physical property; of local communities and of industrial or mining corporations seeking to better existing or procuring new transportation facilities; of a traffic association in special freight rate work. In addition he has investigated specifically the rate structures of certain important traffic territories and published traffic maps, showing graphically their rate adjustments, for the information and use of the traffic officials of the larger commercial and industrial corporations and railroads. It is hoped that this experience, in such diversity of service, may give some assurance to the

reader of his impartial attitude in making the statements of what he believes to be the essential facts and their proper interpretation and relation to each other.

The book may be considered as being divided into two broad divisions of Historical fact and a discussion of the Principles of Rates. The first four chapters, namely, Historical, Promotion, Construction—Reconstruction and Capitalization, are descriptive and historical. The others, on Valuation and Rates, are devoted to the various phases of those subjects.

HISTORICAL

Railoads are the legal and actual successors of the older turnpikes and canals. The invention of MacAdam in the early part of the Nineteenth Century was responsible for the turnpikes, which cheapened the cost of transportation through providing a good solid road for team traffic at all times.

Francis, in his "History of the English Railways," states: "In the Seventeenth Century the charge for conveyance amounted in many cases to a prohibition. Heavy goods cost from London to Birmingham 7£ a ton, from London to Exeter 12£ were paid. Coal was rarely seen save in the neighborhood which produced it." An advertisement of the York and London Stage Coach in 1706 promised to be in London on the fifth day out of York and to run from London to York in four days.

The history of the pre-railroad era serves to emphasize the fact that transportation facilities are absolutely essential to an extensive commerce, and that the present traffic of the railroads is made up in greater part, not of the transportation of commerce existing at the time of their construction, but of that part of it which the transportation facilities themselves have made possible.

The canals, which were the first systems of transportation, were intended, and from their nature could be used only for the transportation of bulky and low-priced commodities. The time required for transportation precluded their use for the carrying of ordinary merchandise of comparatively high value now moved by the railroads under merchandise tariffs. The business on the turnpikes consisted chiefly of carrying this latter class of traffic, the transporta-

tion of which required greater speed than was possible on the canals. The rates charged for carrying such traffic too were very much higher than those demanded for the bulky commodities.

The railroads, therefore, in their earlier history, competed with the canals, which carried bulky freight at low rates, on the one hand, and the turnpikes, which carried higher class traffic at much higher rates, on the other.

Development of the Steam Railroad

Rails were first used in the coal mines of England during the Seventeenth Century to facilitate the handling of the cars used in carrying coal from the working to and from the mouth of the pits. These rails were first of wood, laid flat upon the ground or supported by stones or other device. In 1767 cast iron rails were first used as a substitute for these wooden rails.

The first railroads used generally by the public for the transportation of passengers and freight were laid in the turnpikes. The track consisted of two plain strap rails, laid level with the surface of the road. The railroad company provided only this rail for the use of the carrier, who supplied his own vehicles and teams for moving it.

The next development was a rail with a flange turned up to confine the wheels to the rail. In the last and final development, as to general design, the flange was placed on the wheel instead of the rail, which necessitated the raising of the rail above the surface of the road.

As such construction affected the operation of the turnpikes by the teams not using the rails, and as the operation of the vehicles over the rails laid in the turnpikes necessitated very sharp turns and

steep grades in following the contour of the country, the separation of the rail traffic from the team traffic was suggested, which required a right of way devoted to the rail traffic only, and of the construction of the embankments and excavations, to avoid the expense of ascending and descending the hills.

The construction of the embankments required the building of bridges across the streams, and other forms of construction as we see them now on the railroads. This last development was brought about by the invention of a practical steam engine which could be operated over the railroad.

Modern railroads owe their origin to George Stephenson, the builder of the first practicable steam engine for the Stockton and Darlington Railway, originally operated as a horse railway, and which in 1823 was authorized to use steam for tractive purposes. This experiment proved the practicability of moving people and commodities economically and the enterprise was a financial success for its promoters.

The first railroad, after the invention of the steam engine, charged one rate for the cost of carriage and another entirely separate rate for the use of the road alone. This will be understood from the copy of the original tariff* of one of them which follows:

Tonnage Rates (For use of road only)	Per ton per mile s	 d
For all limestone........................	0	1
For all coal, lime, dung, compost, manure and material for roads....................		1.5
For all coke, culm, charcoal, cinders, stones, sand, clay, building, paving and pitching		

*From Acworth's "Elements of Railway Economics."

	s	d
stones, flags, bricks, tiles and slates......	0	2
For all sugar, corn, grain, flour, dye woods, timber, staves, deals, lead, iron and other metals		2.5
For all cotton and other wool, hides, drugs, manufactured goods, and all other wares, merchandise, matters and things........	0	3

Passenger Rates

For every person traveling thereon not more than 10 miles, in any vehicle............	1	6
For ditto, exceeding 10 miles but not above 20	2	6
For ditto, above 20 miles.................	4	0
For every horse, mule, ass, or other beast of draught or burden, and for every ox, cow, bull or neat cattle carried in or on such carriage, not exceeding 15 miles........	2	6
For ditto, exceeding 15 miles.............	4	0
For every calf, sheep, lamb or pig, any distance	0	9

Carriage Rates

	Per ton per mile s	d
For all lime, limestone, dung, compost, manure and materials for roads, stone, sand, clay, building, pitching and paving stones, tiles, slates, timber, staves and deals.....	8	0
For all sugar, corn, grain, flour, dye-woods, lead, iron and other metals.............	9	0
For all cotton and other wools, hides, drugs, groceries, and manufactured goods......	11	0
For all wines, spirits, vitriol, glass and other hazardous goods.......................	14	0
For all coal, coke, culm, charcoal and cinders		2½

For all persons, cattle and other animals, such rates as the company may decide upon.

It will be noted from the tariff, which was among the first actually used, that the railroads recognized from the beginning that competition, rather than cost of service, controlled the rates. They competed with the turnpikes for passenger and high-class merchandise traffic at high rates, and with the canals for the slow, bulky freight at very much lower rates. The principle thus established has been in effect ever since, not only on English railroads, but on those of all countries. It is mentioned here merely to show the circumstances which were responsible for it.

First Railways in the United States

The Mohawk and Hudson Railroad, now part of the New York Central Lines, started its construction in 1825; the survey of a railroad from Boston to Albany was begun in 1829; in 1830-31 the Boston and Worcester and the Boston and Providence were started; work was begun on the construction of a line from Boston to New York in 1832; construction of the Camden and Amboy Railroad, in Pennsylvania, was started in 1827; the Baltimore and Ohio started its construction in Maryland in 1828.

These railways were naturally built through districts of the greatest density of population. They were begun at the Atlantic seaports and built inland to those points which had been developed more or less by the transportation provided by the canals or other water courses and turnpikes.

The following table shows the growth of the railroads in the United States from 1828 to 1914, both as to absolute mileage and the average annual increases in miles.

Mileage of Railroads in the United States

	Mileage	Average annual increase in Miles
1828........	3	.....
1830........	41	19
1840........	2,200	216
1850........	7,500	530
1860........	29,000	2,150
1870........	49,000	2,000
1880........	93,671	4,467
1890........	163,597	6,992
1900........	193,346	2,975
1910........	240,439	4,709
1914........	252,231	2,948

The construction of new railways in the United States, from the beginning in 1825 to the present time, has been limited only by the capital available for the purpose. The immense area extending from the Atlantic Ocean to the Great Plains, and for some distance eastward from the Pacific, had a favorable climate, fertile soil, virgin forests and valuable mineral deposits, in immense quantities; in much of the intervening mountainous region the most valuable deposits of precious metals in the world were known to exist. Under these conditions it was clear, even in the earlier days, that the transportation of goods, and the products of farm, forest and mine, even in undeveloped territory, would pay for its cost, the interest on the required investments and a profit to the investor. What disappointments there were in connection with such enterprises occurred mainly through lack of capital to complete them and the failure to realize that **time** was a large factor in the transaction—that even with such great **potential** wealth, it required time for converting it into actual

usable wealth and some financial provision for the lean years of the development period.

The domestic capital available for constructing railroads was limited. It was derived chiefly from the shipping interests and the sudden rise of the cotton industry, which occurred at this time. In 1833 the removal of $29,000,000 of government deposits from the United States Bank to state institutions, and the distribution of the government surplus among the states, after the final extinction of the national debt in 1835, made available an increased capital for railroad construction purposes.

Basis for Financing

The first railroads in the eastern states were constructed with funds obtained by subscriptions to capital stock, no bonds being issued. This plan answered very well in territory already developed, but not in undeveloped territory, for the reason that the returns on investments could not be immediate. In that portion of the eastern states in which the railroads connected the larger towns and traversed manufacturing districts, the traffic for the railroad was provided in advance of its construction. The subscription to the stock of such a railroad was therefore a well insured investment, but in the undeveloped territory, where the railroad had to create its own traffic, an investment in its stock was necessarily speculative.

The original stock subscription had called for 8% on the **whole** investment. It is apparent that this stock subscription plan for raising capital failed to use the possible credit of the railroad to its fullest extent. To extend its borrowing capacity, a plan was devised for dividing the capital of the railroad into two distinct parts:

First, bonds, on a loan basis of 6%, secured by the physical property and franchises of the railroad; second, stock, which was unsecured by physical property but which had an interest in the profits of the operation of the enterprise. In order that this form of financing should be as remunerative to the investor as the former 8% subscription shares, a bonus of the stock was given with the bonds to stimulate investment. This made the bondholder, both the creditor as to the cost of the physical property and a partner in the anticipated profits of the enterprise. This plan used to the fullest extent the credit of the enterprise and made feasible much construction not otherwise possible.

From the first, the legislatures of the various states, appreciating the many material advantages to be gained through improved transportation facilities, voted aid directly to such enterprises by way of subsidies, or by purchase or guarantee of the bonds of the constructing companies. This was supplemented in many instances by county and city aid. Prior to 1890 this was a very common practice; since that time most of the states have enacted legislation forbidding the voting of aid by the people of the state, counties, or municipalities for the construction of new railroads.

Foreign Investments in United States Railroads

Construction of railroads had proved profitable in England, where land was high priced and labor in consequence cheap. Land in the United States was very cheap and its potential wealth in fertility of soil and minerals was known to be great. Land in England to be used for railroad purposes had to be obtained by individual bargaining and its cost had been great. The Act of Eminent Domain in the United States provided a means for condemning re-

quired land for railroad use, which made its acquisition comparatively easy and cheap. This one item of real estate alone explains in large part the great difference in cost per mile of English railroads, averaging $200,000, and roads in the United States averaging now for the whole country approximately $55,000 per mile—a little more than 27% of the cost of English railroads.

During the period between 1815-1830 the United States paid 125 millions of its bonds and had extinguished its entire national debt by 1835, thereby strengthening its credit abroad. These were the fundamental conditions which caused the large English and European investments in securities of United States railways and stimulated their construction. This source of supply of capital was restricted by the panic of 1837, at least as to the railroads west of the Allegheny Mountains. The discovery of gold in California in 1849 renewed it and it continued until the panic of 1873. Foreign capital was again invested in large amounts between 1878 and 1892 and was responsible to a large extent for the extraordinary activity in railway construction during the period 1880-1890. The amount of foreign capital invested in the **shares** of United States railways in the period 1890-1896 and the decrease in the amount between 1896 and 1905 is shown by the following tabulation:

*	Per Cent of Foreign Stock 1890-96	1905
Illinois Central	65	21
Pennsylvania	52	19
Louisville & Nashville	75	7
New York, Ontario & Western	58	12

*Ripley's "Railroads—Finance and Organization"

N. Y. Central & Hudson River	37	9
Reading	52	3
Great Northern	33	2
Baltimore & Ohio	21	17
Chicago, Milwaukee & St. Paul	21	6

The foreign bond holdings were probably a larger percentage of the total than in the case of stock.

The following is a statement compiled by Mr. L. F. Loree, President of the Delaware & Hudson Company between October, 1914, and April, 1915, which shows a summary of United States railroad securities held abroad:

Preferred Stock, First	$ 161,281,000
Preferred Stock, Second	100,000
Common Stock	633,802,000
Notes	61,376,000
Debenture Bonds	204,005,000
Collateral Trust Bonds	227,610,000
Mortgage Bonds	1,269,057,000
Equipment Bonds	17,364,000
Car Trusts	808,000
Receivers' Certificates	998,000
Total	$2,576,401,000

Number of roads requested to furnish information	145
Number of roads having securities abroad	100
Number of roads not having securities abroad	36
Number of roads not reporting	9

Causes of Increased Railroad Construction

The territory comprised within the grain-growing areas in the north central states and at least as far

west as the Missouri River, had been very generally settled up by the early '70s. The production of grain at this time vastly exceeded the needs of these communities, but the cost of transporting the surplus to the eastern states and the Atlantic ports for export was prohibitive at the rates then current, on account of the long haul involved. The business of the railroads serving this territory, generally known as "grangers," was unprofitable and in a bad way financially at this time. It was during this period that the price of corn was so low in some of the states within this area that it was used as fuel. It was perceived by the railroads* that a large tonnage at the low rate was more profitable on the whole than a very much smaller tonnage at a high rate. The rates on all grains and other agricultural products were readjusted and reduced to such an extent that the surplus of these commodities could be profitably hauled to distant markets in the east and much of it sent abroad. The adoption of this policy was responsible for the prosperity of the "granger" roads, which immediately followed the reduction in grain rates. Providing a market for this surplus made it profitable to extend the area of agricultural operation in producing more grain, involving the construction of extensions of the existing railroads.

The general effect of this circumstance is to be observed in the activity of railroad construction which prevailed between the years 1878 and 1890. The density of traffic, thus brought about, demanded in turn the reconstruction of the railroads. After the country had recovered from the effects of the

*The result of the competition between the New York Central lines and the Erie Canal was the principal cause for the general rate reduction, the railroad having taken practically all of the canal traffic by low rates. The increased traffic reduced the cost of transportation to such an extent that the lower rates were more profitable than the former high rates.

panic of 1893 and money was again available at reasonable interest rates, a period of reconstruction of the main trunk lines followed, during which immense sums were expended in the rectification of line and the reduction of grade.

In addition there was a very general increase in the size and the capacity of locomotives used, which involved of course a large expenditure in purchasing them. At the same time, it was realized that the percentage of dead weight to the total load of freight cars affected the economy of operation to a large extent. The lighter equipment was replaced by heavier, more economical cars, which while carrying the traffic at smaller cost per unit, involved a large outlay for new equipment.

The reconstruction of the roadbed and the use of heavier motive power and rolling stock, together with the construction of additional main tracks, greatly increased the carrying capacity of the lines as a whole. This increased capacity of the main line was greater however than the capacity of the roads at their terminals. The expansion of terminals became, and still remains, a very serious matter from the operating and financial standpoint. The land necessary to be acquired in making the terminal extensions is many times more valuable per unit of area than the land originally required, and the difficulty of securing capital for this purpose is a most difficult problem for those charged with the financial management of the railroad properties.

Character of Railways

Railways may be divided into three general classes: Military, Political and Commercial. On account of its isolation geographically and its treaties with adjacent countries, military roads are not

required in the United States. The best examples of roads of this class are the network of railways constructed by Germany around all of its frontiers; by France on its northern frontier, on account of the German construction; the Austrian railways, built along its frontiers, and the Trans-Siberian Railway of Russia, constructed for the purpose of rapid mobilization of its army, which is scattered over an immense territory. These roads, while to some extent serving the commercial interests of the countries, have been designed primarily for military use.

The best examples of political roads in this country are the Union Pacific and the Northern Pacific. Prior to the construction of these lines, that portion of the country lying east of the Rocky Mountains had no connection commercially with that lying west thereof, except by the water route around Cape Horn. There was comparatively little commerce between the people of the eastern and western portions of the country, and it is conceivable that without the ties of commercial intercourse, the portion of the United States lying along the Pacific coast might easily have become alienated from the eastern portion.

The Canadian Pacific was built by the Dominion of Canada for the same purpose, and it has had much to do with the making of a united country out of what might well have been unrelated states. The Intercolonial was constructed and is now operated by the Dominion for the purpose of tying together the eastern provinces.

In the period between 1870 and 1913, the Dominion Government has paid in subsidies and in other aid to steam railroads, the immense sum of $269,-000,000. The population in round numbers in 1870 was 3,700,000; in 1911, 7,200,000. This is a very large expenditure per capita, but the development

seems to have warranted it, as such enterprises as the construction of the Canadian roads could not have been successfully consummated without this government aid.

The general policy of the Dominion Government has been to give a subsidy of $6,400 in cash per mile in aid of the construction of new railroads. The provinces supplement this with additional aid, the general subsidy in Ontario being $2,000 per mile in cash with certain grants of land in addition. The total grants given to the Grand Trunk Railway for the construction of its Lake Superior branch totaled $8,400 in cash and 6,000 acres of land per mile of main line.

The general policy of the Mexican Government, during the regime of President Diaz, was to grant government aid to all new railroads, with the same general purpose in view as that of the United States and Canada, namely, the unification of the people of its several states.

Commercial railroads are those which are constructed for the purpose of making a profit from their operation. There are some few exceptions to this, notably the construction of the Cincinnati Southern, by the city of Cincinnati, originally built to protect its southern markets against the competition of Louisville, Ky., and the Baltimore & Ohio Railroad, constructed largely by the city of Baltimore and the state of Maryland, designed primarily to protect the port of Baltimore in its traffic intercourse with the interior, against the competition of the more northern Atlantic seaports.

The discussions contained in the following chapters do not apply to any other than commercial roads as here defined, except where the application is obvious.

PROMOTION

When the production, or the productive capacity of a community exceeds its own needs, as to one or more commodities, there arises a necessity for some means of interchanging its surplus production for other commodities which it requires and which are produced more economically in other communities. Some system of transportation is required to effect the interchange economically.

The work of promoting a railroad to supply this need consists, speaking broadly, of (1) ascertaining as nearly as may be the probable volume of traffic which the interchange involves; (2) ascertaining the approximate cost of constructing the railroad; (3) procuring sufficient funds to construct such railroad and purchase the motive power and equipment required to move the traffic.

Classification

The construction of new railroads may be divided, from a Promotion standpoint, into four classes:

(1) Those constructed by new companies in undeveloped* territory.

(2) Those constructed by new companies in territory served wholly or in part by existing companies.

(3) Those constructed to develop such special commodities as timber, mineral or stone.

(4) Those constructed by operating companies, as extensions of existing lines, into partially developed territory; into undeveloped territory; or to connections with existing railroads.

The procedure in organization, construction and financing will differ very materially for these several

*Territory not provided with transportation facilities.

classes of new lines. Financial considerations will generally be controlling, as the ability to secure capital limits the extent and determines the character of the construction.

Difficulty in securing capital for roads in classes (1) and (2) is much greater than in classes (3) and (4); as the earnings can not be definitely known in advance, the investment is largely speculative in consequence. In the case of class (3), the extent and the commercial value of the area to be developed may be known in advance and the market for the product fairly well defined, for which reasons the element of risk will be small, compared with classes (1) and (2). Class (4) roads have an advantage on account of credit based on the physical property and franchises, together with a known earning capacity of an operating line.

Time Factor in Development

With classes (1) and (2), even when the potential wealth makes **ultimate earnings** certain, the **time** required for development can only be a matter of speculation. Failure to consider this time factor has been the most prolific source of disaster to the original investors in railroad securities. Not only is the capital required for the construction of the road to be considered, but also the much larger capital required for the development of the country, in building new industries, opening mines and developing farms. Evidently this latter development must take place before the traffic of the railroad itself can assume any considerable proportions.

The contract between the Canadian Government and the Grand Trunk Railway, for the operation of the Eastern division, and for the construction and operation of the Western division of the newly con-

structed Grand Trunk Pacific Trans-continental line, recognizes the importance of the time required for development in connection with the construction of new railroads. This contract contains the following provisions, in connection with the Eastern division:

"For the first seven years of the said term the Company shall operate the same, subject only to payment of 'working expenditure'; for the next succeeding forty-three years the Company shall pay annually to the Government, by way of rental, a sum equal to three per cent per annum upon the cost of construction of the said Division, provided that if, in any one or more of the first three years of the said period of forty-three years, the net earnings of the said Division, over the above 'working expenditure,' shall not amount to three per cent of the cost of construction, the difference between the net earnings and the rental shall not be payable by the Company, but shall be capitalized and form part of the cost of construction, upon the whole amount of which, rental is required to be paid at the rate aforesaid after the first ten years of the said lease, and during the remainder of the said term."

It is to be noted that the Government allows the Railroad Company the use of a railroad, which the Government built, for a period of seven years without rental of any kind. It allows a further period of three years if the returns from the operation of the road, over its operating expenses, shall not amount to the 3% of cost, which is the rental proposed for the remaining period provided for in the contract.

In the mountainous section of the Western Division, the Government agrees to pay the interest on the bonds for the first seven years after the completion of the line (with no recourse on the Company for the interest so paid).

Elements of Risk

From this contract it is evident that the risk in such an enterprise to an operating company, for a period of from seven to ten years, is so great that private capital will not undertake it. The contract in effect provides, that the government by remission of its first seven years' rental in one case, and the payment, by it, of the interest charge on the bonds in the other, assumes what is considered to be the entire risk of the enterprise. This contract emphasizes the point, that while there may be no doubt of the potential wealth of a territory and the eventual success of the enterprise, the **element of time** required to convert such wealth into actual useable assets, and thus assure success, is as important as the matter of capitalization itself. The reasonably anticipated returns on capital invested in the construction of roads in classes 1 and 2, on account of the uncertainty of time required for development, must therefore be much larger than for roads in the other classes.

A large part of the original investors in railroads have lost much of their investment. Perhaps 75% of the total mileage of the United States has at some time in its history been administered by a receiver. This, in spite of the fact that the territory developed has been one of great potential wealth and that the railroads have ultimately become paying properties.

Extensions of systems, by the construction at one time of several hundred miles of line, have usually proven very disastrous, not only to the directly interested railroads themselves, but to the general business interests of the country. The history of the Northern Pacific, Santa Fe, Union Pacific and Canadian Pacific are well known illustrations of this fact.

The larger part of the railroad mileage in the United States has been built as class 1 and 2 roads. The present large systems are made up of many short lines, which were originally unrelated local units. The line of the New York Central, from New York City to Buffalo, was originally operated by fourteen different companies. Many roads originally built as class 3 have been improved and extended and fall into class 1 or 2. All of these circumstances have been factors in determining the location, character, capitalization and organization of our railroads as they now exist.

Charter

The first step to be taken in organizing a railroad corporation is to obtain a charter from the state. The reasons for incorporating are several:

(1) The right to collect the charges made for transporting goods, or using transportation facilities, must be granted by the state. This principle was first established when the building of toll roads and canals, constructed by private capital, were authorized by the state, and the railroads are the successors of these earlier forms of transportation.

(2) Without the right—conferred by the Act of Eminent Domain—to condemn land necessary for its right of way, the expense in procuring it would often be prohibitive. Under this right an owner may be compelled by the court to deed his land at a reasonable price, if the necessity for its use for transportation purposes is proven, the theory of the law being that the needs of the public as a whole are superior to the rights of the individual. The state has power to condemn land for public purposes, and it may and does delegate this right, through charter, with reasonable restrictions, to a railway company. Origi-

nally, and particularly in the eastern states, charters were obtained by a special act of the legislature. Now, in all states, charters are granted under the general laws.

(3) To unite the resources of many individuals in a common enterprise. The amount usually involved is too large for an individual or a small body of individuals on a partnership basis.

(4) To limit the individual liability of those participating in the enterprise.

(5) To insure a continuation of the organization of the property, regardless of the death of individual members, which a partnership or other form of organization does not afford.

(6) To provide a means for entering upon the property of others, without trespass, for the purpose of surveying and making the necessary examination to establish the route or secure data relating to the construction of the railroad.

The application for the charter must state the purpose of the incorporation, the proposed route in a general way, the names of the incorporators, the amount of the capitalization and the money actually paid in, and other details varying as to the several states. Some of the states require, before issuing the charter, that the promoters make application to the Public Utilities Commission, or similar body, for a "certificate of necessity" for the purpose of investigating the proposed enterprise, before granting the charter. At the hearing before the Commission, inquiry is made as to the character of the promoters, of their ability to manage the enterprise and raise the necessary capital, whether the proposed line is merely a duplication of present facilities, promoted for the purpose of blackmailing existing companies, or if being honestly promoted and constructed, it

would constitute an additional and unnecessary charge on the communities traversed.

Usually the amount of capitalization of the company, at the time of its application for a charter, will be such as to provide money necessary to; (a) make surveys and examinations of various routes, with maps, profiles and estimates of cost; (b) compile statements and statistics of probable traffic in territory tributary to the line; (c) secure options, deeds and franchises for real estate for right of way and terminal purposes; (d) defray the cost of presenting the proposed enterprise to prospective investors and securing the capital to construct it; (e) pay the cost of preliminary organization and legal expense attending the procuring of the charter, appearing before commissions and such matters.

Cost of Preliminary Work

The actual cost of performing these several services will vary widely with the circumstances surrounding the enterprise. If the proposed railroad traverses communities urgently in need of transportation, or of additional facilities, they themselves will furnish much gratuitous service and the cost of obtaining options or deeds for the necessary real estate will, with favorable local sentiment, be the minimum, as will the collection of data relating to resources and probable traffic and the cost of preliminary organization and legal expense.

In other communities, especially where the proposed line crosses or approximately parallels for some distance roads in operation, and transportation needs are already wholly, or partially supplied, the expense and time required in securing right of way will be vastly increased, not only on account of the lack of interest of the citizens, but often from the

active opposition of the trained organization of the existing railroad whose territory is invaded.

The cost of the surveys will vary with the topography of the country and with the number of cities and towns located along the proposed line, or with the accessability of the district traversed. Surveys in wooded, mountainous country cost more than in prairie country; through open fields, where individual land holdings are measured in acres, less than in cities where land is measured in square feet; in districts having good roads, less than in a wilderness, where roads and trails must be constructed before even survey parties and their supplies may be transported.

Reconnaissance

The work of the engineer will consist first of a reconnaissance of the country to determine, as nearly as may be, the general points through which the proposed line will be constructed. He will note the valleys running in the direction of the line; the depressions in ridges or mountains, separating the valleys; favorable crossings of all streams, as well as of other railways; the location of lakes or other obstacles to be avoided; the most feasable route for entrance into cities and villages, taking into account the character of the property needed or damaged by any particular route he may wish to try. If the line be in a district not thoroughly explored, he will note its natural advantages from a traffic standpoint, such as soil, timber, mineral and stone.

Preliminary Surveys

Having determined on one or more general routes to be tried, a "Preliminary" survey will be made, connecting these various controlling points established by the engineer. This survey will show the

distance between the points and the elevations to be overcome. Often it will be run a second or more times, either in whole or in part, as the first survey will develop features not possible to foresee in the reconnaissance. Surveys over alternative routes will then be made and the cost of construction and the advantages of the several lines will be compared carefully.

The general route being thus established, the location of the proposed line will be made. In the preliminary surveys, the line connecting the several controlling points are "angle" lines—that is, turnings to the right or left to avoid obstacles or to take advantage of favoring topography will be made by turning angles.

Location

In the location, the straight lines between the points will be connected by the curves of the proposed operated line. The located line is a job of "cut and fit"—that is, to so adjust the line to the topography of the country that it may, for any given standard as to gradient* and curvature, be constructed for less money than any other possible line.

As the preliminary surveys progress, a map and profile of the country along and adjacent to the line of survey are made, which show all natural objects and differences of elevation. The located line is first projected on the map and a survey of it is then made on the ground, first by "trial" and next by the final location.

The cost of preliminary lines, per mile run, will be much less than for trial and final location, as in the former, slight turnings by angle are made to one side of obstructions, such as trees and build-

*Gradient is the ratio of rise to distance. If the grade line rises one foot vertically in each one hundred feet, the gradient is 1%.

ings, while the located line must be accurately run as it is to be constructed, or carefully "offset" when the character of the obstruction requires it.

Map

The map of the proposed located line is prepared, showing in detail the topography of the country by contour lines; the exact course of all streams crossed or adjacent to the line; the location of buildings, roads, fences, railroads and all other natural objects; the position of property lines, with owners' names, within say 2,000 feet of the line; the position and distance to government or other established monuments marking recorded land divisions, and every physical detail of the country. It will also show the location and extent of proposed structures; the length and degree of curves; road and stream diversions; the location of proposed passing tracks, sidings, stations, water tanks and all other construction, as well as the acreage of land required for right of way and terminal purposes.

Profile

A profile is prepared showing, by longitudinal section, the variation in elevation of the surface of the ground along the center line of the proposed railroad, with the grade line and the gradients of the finished roadbed; the cubic contents of all cuts and fills and the character of material to be excavated; the length and character of all tunnels, bridges, culverts and other structures within the proposed roadbed.

Estimates

From these maps and profiles, and from notes taken in the field for the purpose, an estimate of the cost of the proposed construction is made in detail,

under the general headings* of Track, Real Estate and Damage, Graduation, Bridging, Buildings, Minor Structures and Miscellaneous.

The preparation of this data is of the utmost importance, as the financing of the entire construction is based on the estimates submitted by the engineer. Even after all of the data mentioned above has been collected, tabulated and digested, there remain questions of judgment of the engineer as to probable cost, and such estimates should always include a percentage to cover contingencies, such percentage varying with the conditions surrounding the enterprise.

Contingencies

This item of contingencies in such estimates is often severely criticised and generally characterized as a "guess." A little consideration, however, shows the necessity for its inclusion.

The cost of the graduation—that is, of excavating the materials in the cuts or borrow-pits for embankments and in tunnels—can not be definitely known in heavy work** until it has been completed and placed in operation, and often not then. An engineer knows that the slopes of any excavation, without regard to the lines which he may design for the finished cross section, will do a certain amount of "slipping" into the finished work. In cases where the construction lies along steep slopes, this slipping may grow into a "slide" of considerable extent—**how** considerable, must always be problematical. It may be a few thousand cubic yards, or it may contain several times the total yardage in his excavation

*Such estimates now are usually made under the thirty-one headings prescribed by the Interstate Commerce Commission for railroad accounting.

**Deep cuts and high fills.

as designed. The Panama Canal is not the only excavation that slips; any excavation exposed to the elements continues to do so, more or less, until it becomes seasoned or sodded with vegetation.

In the excavation of tunnels, even with the most thorough examination by preliminary drilling and test pits, faults in the rock structure, large underground flows of water, strata of clay or disintegrated material, are contingencies which can be provided for in a general way only.

Thorough tests by drilling, or test pits when practicable, confine the estimates of probable cost of bridge foundations within rather narrower limits than in the instances just cited, but the contingency of sudden floods and obstacles in the foundation, not disclosed by the preliminary examination, must be taken into account. Under favorable conditions, the foundation of a bridge pier may be placed within a few weeks if no untoward circumstances intervene. On the other hand, a sudden rise in the stream may destroy a cofferdam which had been placed, in which excavation had been made and masonry foundation started. If a large contingent item has been added and the work is attended by peculiarly favorable circumstances, the estimate is excessive; if conditions are reversed it is insufficient.

The law of averages is the resort of the engineer in such matters. Either his own, or the recorded experience of others, generally both, will determine the proper percentages to add to cost. The difficulty, of course, lies in finding a recorded experience of work exactly like the one proposed, as no two pieces of construction fulfill this condition. In the allowances made for these differences he will show his skill or its lack.

On such items as track—that is, ties, rails and track fastenings—the larger part of the item is ma-

terial, from the railroad viewpoint, the market price of which is not subject to excessive or sudden fluctuation and may be known within small limits of variation. The labor cost for this item will usually not exceed 15% of its total cost and the addition for contingencies will be correspondingly small. The same is true, in a general way, of buildings and minor structures.

The percentage to be added for contingencies on light work—shallow cuts and smaller bridges—will be less than on work which includes deep cuts, tunnels and important bridges. Some illustrations from actual construction, which are given in the following chapter, will serve to show the nature of contingencies which the estimate seeks to cover.

Cost of Surveys

The cost of making surveys and preparing estimates will vary with the conditions surrounding the enterprise, as heretofore noted. The following instances are cited showing what actual costs* have been in certain situations, some of them on work coming under the direction of the author, or within his personal knowledge; others being taken from recorded statements of engineers in charge of such work. These instances are given as applying under the conditions named and are not offered as typical, except for those particular conditions.

(A) In the cleared, hilly country of southwestern Wisconsin, the cost per mile for accepted location was almost exactly $100 per mile, which included all costs as stated in (B). The route was determined in advance by the requirement that the

*These costs are for the engineering work in the field and office and do not include any overhead charge.

line pass through certain towns, situated within a few miles of each other, and close to mine shafts in operation and known mineral deposits. This eliminated the examination of adjacent territory and reduced the cost of examination and surveys to a minimum.

(B) In the rolling prairie country of southern Illinois, with little timber, country largely under cultivation and accessible by roads, the cost of the final location of 115 miles was at the rate of $110 per mile, terminus to terminus. The cost of surveys and examinations in adjacent territory and of abandoned lines is included in this cost, the cost per mile stated being for miles of **accepted** location. This included the salaries, expenses and subsistence of the engineers and the field parties making the surveys, and the drafting and other office salaries and expenses. It involved the running of 285 miles of preliminary line and 160 miles of location.

(C) In Arkansas and Oklahoma, principally a prairie country, with occasional "choppy" topography, partly timbered, the cost of completed location per mile, on the basis of mileage of adopted location, was $192—the average cost per mile of preliminary survey being $26 and of location $71*

The location involved the examination of several alternate routes, the country being in large part undeveloped territory, the surveys being made before the "Indian Territory" was made a part of the state of Oklahoma.

(D) In the wooded, mountainous country of West Virginia, the Little Kanawha Syndicate spent $151.53 per mile of located line, running 1,426 miles of preliminary line and 602 miles of location. This

*Report of Mr. Lavis, C. E., on the Choctaw, Oklahoma & Gulf R. R., now part of the Rock Island System.

cost includes all salaries, field and office expenses, purchase of instruments and supplies incident to the making of surveys and preparing maps, profiles and estimates, with everything ready to contract for the construction of the line. On the basis of the main line mileage, terminus to terminus, omitting located line abandoned, the cost was $278.23 per mile of line.

(E) For a belt line in a city of 30,000 population, in western Kentucky, with a connecting line 10 miles in length, to a river crossing, the survey and preparation of maps and estimates, cost at the rate of $350 per mile, on basis of 10 miles. The work involved the mapping of existing railroads in the city and the survey of short lines connecting them at various points.

(F) In Canada, in the uninhabited territory lying between the existing railroads and Hudson Bay, the engineer reporting to the government on the probable cost of the surveys stated:

"The experience of the Canadian Northern and Grand Trunk Railways seems to indicate that the cost is usually from $300 to $500 per mile for a final location in such a country."

It will be noted from the foregoing that in a developed country, devoid of timber, with the possible location confined within narrow limits, the cost of making surveys and estimates will be the minimum —as shown by (A); that the cost will increase with the number of possible locations to be examined— as shown by (B) and (C); that in wooded, mountainous country the cost is almost three times the minimum cost—as shown by (D); that in uninhabited territory, difficult of access and distant from transportation facilities, the cost may be from three to five times the minimum; that for city districts (small cities) and immediately adjacent territory,

the cost is three and one-half times the minimum noted. In large cities it will be much greater than this.

Estimating Traffic

To arrive at the probable traffic that may be reasonably expected at a given time on a proposed railroad is a difficult task, and, except in special situations, it can never be determined with exactitude. The best that can be done is to state that it will not fall below a certain figure and that it will probably not exceed some other figure; of many enterprises even this much may not be determined in advance with certainty. This fact is to be remembered, not only in its application to the following discussion, but also in connection with the financing of the project, upon which it has a most important bearing.

An obvious exception to this statement is that class of railroads, usually short, but often important from a traffic standpoint, which are constructed especially to develop some commodity, as lumber or coal and other products of mines, in a particular locality.

In these instances, the extent of the timber tract, or of the mineral deposit, the cost of manufacturing or producing it and the extent of the market for it, may be known within comparatively narrow limits of variation, and the traffic offered for transportation may be determined accurately in advance. There are, of course, fluctuations in the demand for even these every day necessities, but they are those of ordinary business and are not peculiar to the business of transportation.

The traffic on this class of roads will rarely bear any important relation to the population of the territory traversed or that adjacent to it.

Methods of Estimating Traffic

There are three general methods employed in determining the traffic expectation of a proposed road:

(1) On the basis of population in the territory tributary to it.

(2) By estimating each possible source of traffic in detail—as the production of each factory, sawmill plant, and even individual farms.

(3) By comparison with railroads in operation in similar territory.

The first method involves the determining of; (a) the factor of annual revenue per capita and; (b) the population of the territory which may be considered as tributary to the proposed line.

The reports of the Interstate Commerce Commission are the reliable sources of information as to the operating statistics of the railroads.

The area of the United States is divided by the Interstate Commerce Commission into ten groups, as shown on the map. The Interstate Commerce Commission's reports give, for the United States as a whole, and for each of the ten groups, the gross earnings per mile of road operated and, formerly, the per capita earnings.

The average earnings per capita for the entire country is of little value in determining the prospective earnings of any particular line of proposed road. Neither is the average earnings for the entire group in which the proposed line is located serviceable, even as a very rough approximation. The following table given in the Interstate Commerce Commission's report for 1900 will serve to illustrate this fact. (The report for 1910 does not contain similar information, which explains the use of tables now out of date, but the figures are close enough to the truth for this illustration.)

TERRITORIAL GROUPS OF THE UNITED STATES ADOPTED BY THE INTERSTATE COMMERCE COMMISSION

Revenue Per Capita by Groups
From I. C. C. Report 1900

Group.	Total revenue.	Pass.	Freight.	Percentage of total Pass.	Freight.	Other.
1....	$17.31	$6.59	$9.26	38	53	9
2....	21.55	4.75	15.43	22	72	6
3....	23.14	4.68	16.74	20	72	8
4....	10.39	2.18	7.46	21	72	7
5....	10.62	2.12	7.65	20	72	8
6....	23.74	4.64	17.04	20	72	8
7....	35.05	6.60	25.77	19	73	8
8....	20.30	3.77	14.76	18	73	9
9....	13.97	2.55	10.44	18	75	7
10....	30.49	7.90	20.49	26	67	7
Entire U. S.	19.67	4.28	13.88	22	70	8

The passenger earnings with variations from $2.12 to $7.90 per capita, and the freight from $7.46 to $25.77 per capita, show that the average for the entire United States is not applicable to any particular line.

The large total earnings per capita in Group 7 is caused by the fact that the proportion of the rates on through business between groups lying on either side of it is credited to Group 7. As the area in Group 7 is large, the population small, the length of line great, relatively, the earnings per capita are much above the average for other groups. The point to be noted is, that the figure per capita would have no value as indicating the probable revenue to be derived from developing the territory within Group 7 itself, as the revenue is not derived from traffic originating in or destined to points located in that group. The same is true, in lesser degree, of Groups 8 and 10.

The earnings in Groups 2, 3 and 6 vary within narrow limits and are large on account of the terri-

tory being adapted to agriculture, manufacturing and mining, which interests interchange their respective products.

The products of Groups 4 and 5 are in the main agricultural, and the per capita earnings are small. These groups, however, contain such districts as the coal fields of West Virginia and the manufacturing and mining districts of Birmingham and Chattanooga, where the per capita earnings of individual lines are large. Evidently the average for the groups would not apply to a railroad developing a mining district within them.

The second method, if used at all, requires much skill and good judgment, based on experience, in applying it.

It is not a difficult matter, although it usually entails much labor, to make an inventory of all sources of traffic within a given area at the time the investigation is made. This does not solve the question completely, for in all new enterprises it is the further development of existing sources of traffic and the creation of new ones that furnish the profit to the railroad. To estimate the extent of prospective business is a difficult matter; to predict with any certainty the **time** required to develop the anticipated increase—which is more important to the original investor than the ultimate amount—is not possible. At the best, this method can be only an educated guess; it serves, however, to check other methods.

The third method—by comparison with other railroads in similar territory—is much more satisfactory. There are no two railroads exactly alike as to conditions surrounding their operation, and the skill of the estimator in making allowances for the differences will be the measure of the accuracy of the estimate.

The operating factors of an entire system of railroad, comprising several thousand miles of line traversing territory with varying characteristics, are not applicable to a new railroad, say 100 miles long. The figures of a division or a shorter unit are the ones to be applied.

Not only are the earnings of the operated road at the time of the investigation to be secured, but if possible the earnings in the years immediately following its completion, as the **time** required to develop the traffic is the essence of the estimate, from the standpoint of an investor in a new railroad.

Detailed Analysis Important

In determining the extent of the territory to be considered tributary to the proposed line, the maps of the country traversed and adjacent to it must be studied in detail. The shipper may always be relied upon to go to the railroad most convenient for him. The location of ridges, character of roads, and position of bridges over large streams will often determine the boundaries of the actual tributary territory. After the boundaries have been defined, the actual population at a given time may be obtained from the school census and other sources, the growth in population in recent years being also noted as forming a basis for the prediction of **prospective** traffic.

Where there are other railroads serving the towns along the proposed line, the whole population cannot be included in the estimate of population served by it. A percentage based on the number and relative importance of the several lines to the particular community considered will be used. Such circumstances as the location of the several freight stations of competing lines must be taken into account. If a

shipper has a choice of delivering goods to a station within two or three city blocks, he will rarely haul it one mile to another, if the loading and transportation facilities are equal. Failure to realize the importance of such matters has resulted disastrously to some prominent enterprises, one illustration of which will suffice.

The line of the New York Central between Chicago and New York, built during the early days of railroad construction, penetrated to the centers of business at its termini and passed through the business centers of all cities and towns along the line. The eagerness of the various cities and towns for transportation facilities and the comparatively low price of land at the time of construction, made this possible.

In the '80s, its entire line between these termini was paralleled by competing lines. The construction of the first line had increased the population of all of the cities and towns, and in consequence the price of real estate had been multiplied many times. The cost of real estate and consequential damage forbade the construction of a new line into the business centers of the termini and the intermediate cities. In consequence the stations of the new lines were located at some distance from the business centers, and the cost of delivery of freight was greater to such stations than to those of the older road. There was no reason why a shipper should pay more for hauling his freight to and from the new station, and this meant that either the old road obtained practically all of the business or the new road was forced to make a concession to the shipper (reduce its own revenue) to compensate him for the increased cost of trucking his freight a greater distance. A careful analysis of the traffic expectancy would have disclosed this fact as to the intermediate towns,

At the New York terminus a different condition obtained. As the terminus of the new road was across the Hudson River, it involved, for a passenger, a ferry trip across the river and a long ride thereafter to the business center of New York, while the terminus of the old line was in the city near its business center. Evidently no great amount of passenger revenue could be anticipated for the new road without making concessions in fare (reducing its revenue) to the passenger.

The freight situation in New York was somewhat different, however, because a large proportion of transfers to freight terminals was made by car ferries on the rivers, and the terminus of the new road was about as favorably situated for this purpose as the old. Its freight traffic expectancy at New York, therefore, was comparable with that of the old road.

It is needless to add that, in the competition for business which ensued between the new and the old roads, the newer roads were forced into bankruptcy. This instance is given to emphasize the need of considering **all** of the factors in making or analyzing traffic estimates; many others, similar in a general way, might be quoted.

To determine the earnings per capita of the **operated** line, with which the comparison is made, an examination of its territory should be made in the same manner as above outlined. Due allowance being made for differences in surrounding conditions, the revised per capita earning is applied to the population within the area tributary to the new road, and its gross annual earnings thus estimated.

In this connection, the matter of **division** of rates on the prospective traffic should be made a special study. The practice of allowing the road which originates or delivers the traffic a certain arbitrary amount or a minimum percentage of the entire trans-

portation charge from origin to destination, without regard to the **distance** which the originating or delivering road may move the traffic, is recognized by all the railroads of the country.

The revenue derived from any shipment passing over more than two roads will generally be divided pro rata, on a basis of mileage, after the deductions of the minimums allowed for the originating and delivering lines have been made. On many roads this principle of "minimums" will affect the revenues radically, which the following example will serve to show:

An independent railroad, 25 miles long, serves a mine producing ore, which is shipped a total distance of 400 miles to a smelter, over the originating line A and its connecting line B. The freight rate is on the basis of 5 mills per ton-mile, making the total revenue $2 per ton. If "A" is allowed a minimum of 25%, its proportion of the revenue will be fifty cents per ton; if the division is made on the mileage basis, its proportion will be one-sixteenth of the total revenue, or twelve and one-half cents per ton.

The principle involved is, that the revenue of a railroad is not in all cases based on the product of its tonnage by a fixed rate per mile of its haul. If its traffic is made up largely of business which it delivers or originates, its revenue per ton-mile will be comparatively large; if it is made up principally of business in which it acts as an intermediate carrier, its revenue per ton-mile will be small.

On all large systems, the business consists of a large amount of both classes of traffic; on shorter lines and smaller systems, it may, and often does, consist of a great predominance of one class over the other, and in consequence any given tonnage will in the one case produce a much greater revenue than in the other.

In the past, traffic estimates have not generally received such detailed analysis, but have consisted principally of the personal opinions of the estimators, more or less expert, with little reliable data to support them. The margin of profit in transportation has now become so narrow that the better methods are absolutely essential in making even approximate traffic estimates.

This discussion shows clearly, however, that as to the roads built in the earlier periods of railroad construction, and as to all roads in undeveloped territory, the element of risk for those investing in such enterprises was very large indeed on account of the uncertainty of the estimates of traffic expectancy.

The cost of making traffic estimates will vary with the conditions. In the case of a short extension of an operated road, the estimate is usually made by its chief traffic officials, the field work of gathering data being done by one or more of the minor traffic officials.

In the case of an extension of several hundred miles, or of a new company, or of an independent investigation by the prospective underwriters of the enterprise, it would involve the payment of a large fee for the services of a traffic expert and the employment of enough assistants to collect the data and tabulate and arrange it for consideration and analysis. The costs per mile vary so widely that the figures for any particular situation would serve no useful purpose for specific application, even if such figures were available.

Real Estate and Franchises

In the earlier period of railroad construction, at least for the first one or two railroads traversing the same territory, the difficulties and cost of obtaining

land for right of way, depot grounds and terminal purposes were the minimum. In many instances the required land was given without cost to the railroad, and in addition a bonus in money. The promoter, in presenting the matter to prospective investors, was often able to show deeds for the larger part of the required land and guarantees of the several communities covering the cost of acquiring the balance.

The difficulty and cost of acquiring land for a railroad varies with the character and extent of the transportation existing in the territory traversed at the time of the proposed construction. This is as true now as it ever was, the difference between present and earlier conditions being, that in that portion of the country east of the 100th meridian and west of the 120th, the country, **generally,** has been provided with transportation.

Webb, in "Economics of Railway Construction," illustrates this. "If the whole country was gridironed with railroads running north and south and east and west, at a distance apart of 25 miles, only one point in each square would be as far as 12.5 miles from a railroad. Such squares would have 50 miles of road for 625 square miles of territory, or 8 miles for 100 square miles of territory. The average for the whole United States, 8.08, is even now (1912) greater than this. Maine is the only state east of the 95th meridian in which the number is less than 8."

This means, generally speaking, that railroad construction east of the 100th meridian will in future consist of short lines or branches from existing roads. The most notable exception to this will be the rare construction of new connections between large systems, necessitated by radical changes in management.

Options and Franchises

With the exception first noted, the cost of real estate is an important item for a proposed railroad, being a considerable percentage of total cost. To estimate it exactly, in advance of its acquirement, is not possible.

In so far as practicable, options will be taken on needed land immediately after the location of the line is decided on, and in many instances before even a survey is made. These will state the price at which the land owner will deed the required property within a stated period of time.

Under favoring conditions the cost of the option of purchase will be nominal in small towns and country districts. Unless there is some urgent demand for the road, (and with some owners in any event) the price demanded for the option may be a considerable percentage of the purchase price.

For property within cities, particularly the high priced property, the option will rarely be given without the payment of a substantial percentage of the purchase price. The point to be noted in this connection is, that the possible amount of loss to the promoters is seriously affected by the ease with which the options are obtained, and the amounts of the cash payments made to secure them, for in case the line is not financed, the amounts so paid are irrevocably lost. This condition increases the risk to be assumed by the promoters of the enterprise.

In addition to the charter secured from the state, it will be necessary in most states to obtain from the County Commissioners (in some states Public Service Commission or similar body) the right to cross the public highways and, from incorporated cities and towns, the right to cross or occupy public streets and other public places or property. This

may be a simple matter or a very complicated one, involving the expenditure of considerable sums of money and much time. Some of our worst municipal scandals have arisen in connection with the procuring of railroad franchises in cities.

Elements of Cost and Damage

Some of the right of way must be condemned, even under the most favorable conditions. The courts must authorize the passing of title to land taken from any estate in which minor heirs are interested. No agreement between administrators of such estates involving the title of land is valid without the sanction of the court.

In all cases where the company can not agree with the land-owners as to price of land to be acquired, the value of the land taken and the consequential damage to adjoining land must be determined by a jury or commissioners appointed by the court. The item of **damage to land not taken** is the serious one for the railroad company, as the following illustrations will show: (See Figure No. 1.)

The court instructs the jury to determine three separate and distinct things:

(1) The market value of the tract of land taken by the railroad, in this case 5 acres.

(2) The damage to the two remaining tracts, "A" containing 20 acres and "B" containing 615 acres.

(3) The benefit to A and B which may fairly be expected from the operation of the railroad.

The market value of the right of way is proven by witnesses to be, say $100 per acre. The triangular strip "A" is cut off from the balance of the owner's land "B" and subjects him to perpetual inconvenience and danger in crossing an operated railroad

in doing his farm work. Furthermore, his field is not square and it will not be possible to convince a jury (or a judge either) that such a field is as desir-

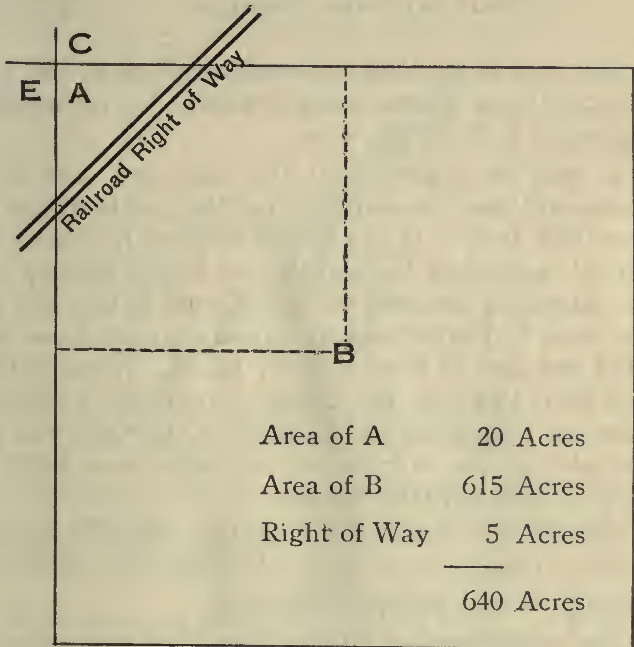

Figure 1.— Land Damage

able as if it were, in spite of the fact that it will raise as much corn or wheat per acre in its triangular form as it did before. The very best that the company could expect as to "A" would be the assessment of 50% of market value as the damage (whole damage less benefit.) As to "B" it is no longer square and to the ordinary jury, particularly in an agricultural community, a net damage of $5 per acre seems not excessive.

The cost of land and consequential damage to the railroad company for the five acres actually taken is:

Five Acres of Right of Way at $100....	$ 500
Damage to A—20 Acres at $50.........	1,000
Damage to B—615 Acres at $5.........	3,075
Total Land and Damage.........	$4,575

The cost to the railroad company is $915 per acre, through land whose market value, for agricultural purposes, is $100 per acre.

It may be argued that the supposed case is extreme and that the ordinary holdings of land are less than 640 acres. If the entire holding had been 160 acres, (as shown by dotted line in the figure) with the damages assessed as in the case noted, the cost per acre to the railroad company would have been $435 per acre of land actually taken. If the holding had been 40 acres, the damage would have been the same on both sides of the right of way and the cost per acre to the railroad would have been $450 per acre of land actually taken.

Should the construction of the roadbed contemplate a deep cut or high fill across the land, the damage is still further increased.

The consideration of the fact that the owner of "A" may sell to "C" or "E" and that the damage and inconvenience of cultivating "A" on account of the railroad crossing would thereby be eliminated, is not allowed, the damage being assessed on the basis of continued ownership of "A."

The conditions shown in Figure 2 are not uncommon. The land value and damage is determined as in the instance just given, but there must be added to it the damage to improvements. Even though the right of way of the railroad does not actually include any part of the residence, barn or water supply, it destroys the home site, making it impracticable (practically impossible) to use the buildings for the

purpose for which they were constructed. An investment of $3,000 in residence, barn, granary, poultry houses and sheds for farm tools, would provide only a very modest home place and its whole value

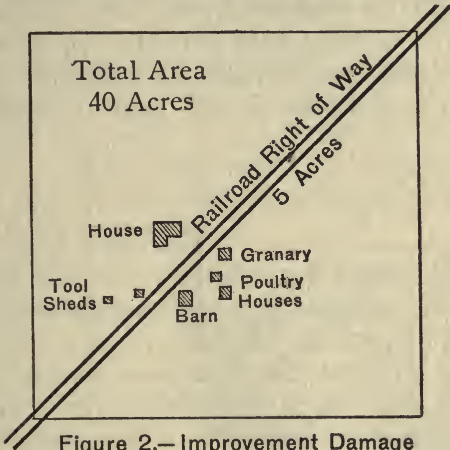

Figure 2.—Improvement Damage

is practically destroyed for that purpose. The cost to the railroad company for the five acres of land required by it is then:

Five Acres of Right of Way at $100....	$ 500
Damage to 35 Acres at $50.............	1,750
Damage to Buildings and Improvements.	3,000
Total Land and Damage........	$5,250

The cost to the railroad company is $1,050 per acre, through land whose market value is $100 per acre.

The instances just given apply to cost and damage of agricultural and other land outside of cities and towns; the following relates to the cost and damage within cities.

It is to be noted; first, that the individual tract of land (city lot) within cities is much smaller than

in the country; second, that the area within cities has generally been improved with buildings and other construction to a much larger extent than in the country. By reason of this the consequential damage to land will be comparatively less (a smaller percentage of the total cost per acre on basis of land required) and the damage to buildings and other property much higher in city than in country property.

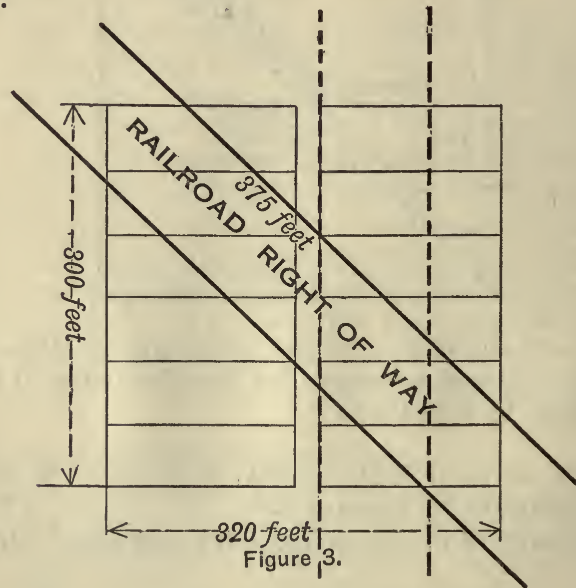

Figure 3.

The sketch shown as Figure No. 3 illustrates the condition in subdivided city property. It represents a city block, containing 12 lots with a 50 ft. frontage 150 ft. deep, with a 20 ft. alley between the lots.

The most unfavorable condition is the location of the right of way as shown by solid lines. In this case it is evidently the better policy to buy the whole block, to avoid contingent damage suits by the owners of the only two lots in the block not actually touched by the right of way lines.

Suppose the value of each lot, which contains (150 ft. x 50 ft.) 7,500 square feet, is $100; the value is one and one-third cents per square foot. The area within the block, actually occupied by the right of way, contains (375 ft. x 100 ft.) 37,500 square feet, which at the rate of one and one-third cents per square foot makes its value $500. The twelve lots which must be taken will cost $1,200, or 2.4 times as much as the value of the property actually required for railroad purposes. In addition to this, the entire value of all improvements on the property must be added to the cost.

The most favorable condition is the location of the right of way shown by the dotted lines. In this case the six lots on the right side of the alley must be taken and the railroad company is liable for contingent damage to the property on the left side of the alley, if it is of such a character (as residence property) that the facts will support the claim.

The railroad company must pay all of the costs of the proceedings in condemnation suits. Where the number of condemnations is any considerable percentage of the total, it will add materially to the cost of the land required.

This fact has a bearing on the price to be paid for land **not** obtained by condemnation. The buyer for the railroad company has two limits to the price he will pay; one its market value without any addition, as the minimum; another the value which experience teaches him the land owner may obtain by a condemnation proceeding, **plus the cost of the condemnation proceeding.** The land owner, or his lawyer, will also have an idea of value based on this latter consideration, and the railroad buyer will give his maximum price before going to court, to avoid the delay and the **risks** of an uncertain jury.

Statistics show that, through farm lands, the actual cost per unit of land (as an acre) is, as an average for a whole line, from 2 to 3.5 times its market value; through incorporated towns and cities from $1\frac{1}{4}$ to $2\frac{1}{2}$ times the market value. The explanation of the latter factor being lower than the first lies in the fact that the company, within incorporated limits, usually buys all of a tract of land which its right of way encroaches upon, however small the area involved may be, and the consequential land damage as a result is smaller than in the case of farm lands where the damaged area not required is generally large.

The circumstances related above are the basis of the oft-repeated complaint of the railroads that they pay much more than anybody else for land. The truth of the matter is that their cost includes more than one item, viz.:

(1) Cost of land purchased **under necessity** both as to **time** and **location.**

(2) Consequential damages to land not taken, by reason of the impracticability of the location of its right of way following or conforming to established land lines, and of the nature of the use to which the land is put—danger, delay and inconvenience to its neighbors from operation of trains.

(3) Damage to improvements, such as buildings, water supply and the rearranging of division lines within an owner's tract.

(4) The expense of procuring the land by condemnation proceedings or otherwise, involving employment of experts, expensive court costs, attorney's fees and long delays to construction.

If a manufacturer's plant, from the nature of its operation required a long "shoestring" of land, partly straight and partly curved, winding in and out between and into buildings constructed for other

purposes, in a district theretofore devoted to other purposes than manufacturing, as residence property, his costs would approximate the railroad companies' cost.

Many construction, and practically all physical valuation estimates of cost of railroad real estate, have been made by applying the factors above mentioned to a proposed line or the particular section of operated line under consideration. That is, the number of acres in any agricultural section was multiplied first by the ascertained market value and then by a factor of say three (the one commonly employed) ; in areas within incorporated limits the market price was first multiplied by two and this product was applied as a unit cost to the land under consideration.

The conditions surrounding different lines of railroads vary so widely, that the results thus obtained are not even fair approximations. The work involved in giving each tract of land or each block, or several blocks of property, detailed consideration is necessary and well repays the cost and time required. Even so the estimate will be based on many uncertainties and must be stated with many reservations.

Relative Importance of Real Estate

For new railroads traversing an agricultural district in greater part, the cost of the real estate will not usually fall below 10% of the total cost of the road (note specific exceptions heretofore referred to) ; nor will it often exceed 25% of such total cost. For railroads constructed largely in and adjacent to centers of population—as belt lines and connecting lines in and near large cities—the cost of the real estate rarely forms so small a percentage of the

total cost as 25% and often is several times the total cost of all other items.

Securing Capital

The cost of presenting the data heretofore mentioned and of securing the needed capital for construction, will be very much larger for new companies than for the older operating companies making extensions. In the one instance the investment is to be based on **faith** in an untried venture; in the other on past performances of a property and its management.

In the latter instance, provided its reputation justifies it, the presentation to bankers who underwrite such enterprises is comparatively a simple matter, attended to by the executive officials of the operating road. These bankers, after examining the data submitted and getting the opinion of their own experts as to its reliability and the correct interpretation of what it means from an economical standpoint, accept, reject or defer, as the case may be. If the promoter of the new company can impress such bankers favorably at the start he is, indeed, fortunate above the majority of his kind.

Details of Financing

In the earlier days of railroad construction, particularly in that portion of the country west of the Allegheny Mountains, a not uncommon plan adopted was to obtain a portion of the money by local subscription within or adjacent to the territory to be traversed by the proposed railroad, and a certain other portion from eastern or foreign syndicates.

If the local subscriptions were of an amount sufficient to provide for the real estate, grading, bridging (except important iron or steel bridges) and ties, it was not difficult for a meritorious enterprise to ob-

tain money for the important bridges, track superstructure—rails, fastenings and switches—and for the motive power and rolling stock to operate it.

The wealthier members of the local community had either large holdings of land or controlled the conduct of the larger business interests, which were certain to be very greatly benefited by the railroad—in some cases their value would be more than doubled immediately after the lines were placed in operation. In so far as their assets or credit permitted, it was a good business proposition to make the utmost possible sacrifice to obtain the improvement, even if it did not in itself pay a return on the investment or proved eventually a partial or complete loss. (In very many instances it did involve a complete loss for the original local investors, so far as the railroad investment itself was concerned.)

It will be noted that the grading and the timber for bridges, culverts and ties and what payments were required for land, did not involve the sending of money outside of their own district, as local labor and resources provided them.

With these items of construction provided for, the risk of the outside capital was very much reduced, particularly if the local subscribers' investment was represented by stock and the outside investment by bonds, with a bonus of stock—which was a very usual condition. It will be noted, too that the contingencies of construction which may be large in real estate, grading and bridging, are remote in such items as bridge superstructure, track and equipment.

The bonds were secured by the real estate, the grading, a larger part of the bridging and the ties, for which **no bonds were issued,** and by the rail and equipment for which **bonds were issued.** The bonds, therefore, had a relatively large value of physical property as security and hence a reasonable margin

of safety, and their owners an interest in prospective profits, through their holdings of the stock bonus. Further, the enterprise was protected from hostile local legislation, to which foreign capital is sometimes subjected, by reason of the local interest in the profits of the enterprise.

If the promoter could obtain through state, county, city or township aid, the entire amount which the bond investor would not supply, his task, though large, was confined within definite limits and consisted in convincing the several communities of the merits and importance to themselves of the enterprise. Such aid often had to be supplemented by individual subscription, which involved an immense amount of personal work and long delays.

State, city and county aid are now generally forbidden by statute in the various states, and wisely so; for the greater part of the time during which such aid was given, however, it was beneficial and wise legislation, the abuses which finally discredited it being assignable rather to lack of proper supervision in extending the aid than to anything inherently wrong in the principle as applied to a country urgently in need of transportation.

With variations to meet local conditions, this plan was very generally followed in much of the early construction—in fact, was the only practicable one by which so large an area could have been developed within the time in which it was accomplished. Usually, extensions to the lines so constructed were then made as first outlined above.

Cost of Promotion

The actual cost of promotion is seldom obtainable. In fact, it may be anything from a fraction of one per cent to twelve per cent of construction cost. In estimates of physical valuation it is generally in-

cluded as a part of the "General Expenditure" item, which latter item is stated as a percentage of total cost, without any specific amount or percentage being assigned to promotion separately. A few known instances may be of interest, although they have no general application. The promotion costs next given cover all expenses ready to let construction contracts.

The cost of promoting a line, 170 miles in Illinois, through a good agricultural country, under consideration for three years, was one and one-half per cent of estimated construction cost of railroad and equipment.

The promotion expenses on the K. C. M. & O. R. R., 610 miles long, from Wichita, Kas., to Fort Sill, Tex., exceeded 10% of the construction cost.

The promotion expenses of a twenty-five mile line in Wisconsin was less than one per cent of its estimated total cost.

Acworth, the English authority, in "Railway Economics," states that the probable cost to English railroads for promotion has been, as an average, $20,000 per mile. This covers the cost of parliamentary and all other proceedings preliminary to construction.

Element of Risk in Promotion

By far the larger part of the railroads which have been promoted have never gotten any further than the promotion stage. To say what proportion of the roads promoted have actually been constructed would be hazarding a guess, for there is no record covering the matter. We have now in the country something over 250 thousand miles of railroad, and it is safe to say that certainly more than four times that mileage has been promoted.

A reference to the files of the "Engineering News" and other such papers, which record weekly what is termed "Construction News," but which is oftener "Promotion News," will disclose how many railroad enterprises relatively get to the actual construction stage.

During the period of active railroad construction, extending from 1880 to 1907, several pages of the periodical mentioned were covered by short announcements concerning proposed railroads which were under survey preparatory to submitting them for the purpose of financing. The same pages contained notices of contracts for railroad construction work which had been awarded. The promotion notices during the period mentioned were certainly as high as ten to one of actual construction.

This statement is not made for the purpose of establishing an absolute or definite percentage which has existed between promoted and constructed railroads, but only to make clear that the number of promoted railroads has exceeded the number of constructed railroads many times.

The practical application of this fact is, that promotion instead of being very profitable, has been, **as a business,** very unprofitable, even though in some instances individuals have made some money out of it. As a corollary of this, the chance of loss of money invested in promoting railroads is very large indeed—perhaps as great as for money invested in prospecting for minerals under expert advice.

Many railroad enterprises which have survived the promotion stage have been constructed to the extent of providing a roadbed and the smaller bridges for the track, on which no track has ever been laid. This class of abandoned railroad construction is scattered all over the country, in the

central, southern, and eastern states. Some of these, particularly in mountainous districts, have involved the expenditure of large sums of money. Today these expenditures are represented only by a scar on the landscape—a nuisance obstructing beneficial use of the land. They serve as an enduring illustration of the fact that availability of capital is the controlling factor in the construction of new railroads, and that money invested in them is subject to a very large element of risk.

Summary of Promotion

From the foregoing relation we may summarize the prominent facts and conditions relating to the promotion of railroads:

(1) The difficulties and expense of promotion are proportional to the risk involved in the enterprise, being much greater on new lines than in the extension of existing operated lines.

(2) The very large element of risk involved in operating new railroads is recognized in recent contracts of the Canadian Government covering a large mileage, these contracts being based on the premise that the revenues of the roads for a period of from seven to ten years will not exceed the operating expense—the interest on the investment meantime being assummed by the government. This supports the statement that the original investors in railroads in the United States have very generally lost a large part of the interest on their investments and often all of their investments as well.

(3) The element of risk attending the extension of existing operated roads is less than in the case of new roads. Extensions of existing operating roads, involving the construction of several hundred miles of line at one time, have invariably been dis-

astrous, as the records of the Atchison, Topeka & Santa Fe, Union Pacific, Northern Pacific and Canadian Pacific show.

(4) Promotion is a valuable service rendered in supplying an urgent public need. It is **real** work, of an expert character, demanding exceptional qualifications. It must provide many definite things, such as obtaining a charter, franchises for the use of streets, roads, and other public places; an accurate survey of the entire country to be traversed, and a definitely located line, with maps, profiles, and estimates of cost; a large amount of statistical data relating to probable traffic which must be gathered in the territory to be served, tabulated, and properly interpreted. All of this work must be performed by trained men, expert in their particular lines.

(5) Money must be provided for performing these several services; the preliminary expense of obtaining the charter and forming a legal organization; the cost of making the surveys, which involves the employment of large forces of field and office men, and the payment of the cost of securing traffic data in the field, of compiling it in the office, and of analyzing it by a traffic expert. In the aggregate these expenses may be anything between 1½% and 12% of the cost of constructing the line, the ordinary cost being near the lowest stated.

(6) In connection with the reliability of the data prepared for promotion purposes (this affects the matter of procuring capital), the contingencies attending construction are known to be many, and this knowledge tends to cast doubt on the reliability of the estimates of the engineer as to cost. The nature of the work, the construction of bridge foundations, erecting large spans over deep rivers with treacherous bottoms, the large slides, the almost certain washouts during construction or early operation for-

bid an accurate determination of cost in advance of actual construction. Even with the most expert assistance and close analysis, the estimate of traffic expectancy of the line contains many elements of uncertainty. The cost of the required real estate and the delays incident to acquiring it may not be known in advance with any exactness. That is, the estimates of cost, even under the most favorable circumstances, are uncertain and based on judgment largely.

(7) It follows from (6) that an investment in new railroads must be based largely on faith. It is difficult to procure capital on that basis and the return on the capital must be large indeed to justify the investment.

The securities of new railroads in consequence have seldom been underwritten, except as to a small percentage of the total, by bankers. The capital has been secured from local investors and through aid granted by municipalities and states. Such investment and aid have been based on the benefits to be derived from the operation of a transportation facility and not on the basis of anticipated monetary return on the investment itself.

Securing capital from such diverse sources required much work and time, and necessitated the employment of men of exceptional qualifications.

(8) The rewards of promotion have not been great to the promoters themselves as a whole, though they have been, in exceptional cases, profitable to individual (or groups of individuals) promoters.

CONSTRUCTION-RECONSTRUCTION

Engineering

When construction of a proposed railroad is decided upon, it will be carried out under one of the three plans described later in this chapter. Whatever method is employed the Constructing Engineer will have entire charge of, and responsibility for the construction of the work.

It will be divided into sections called residencies, varying usually from 8 to 15 miles in length, according to the nature of the work. Each of these sections will be assigned to a Resident Engineer, who will have immediate charge of all construction. In cases where the length of the proposed line requires it, these Resident Engineers will report directly to Division Engineers, who in turn report to the Chief Engineer.

The Resident Engineers "cross section" the line to determine the quantities of grading, place stakes marking the edges of excavations and "toes" of embankments, indicate on the ground by stakes the dimensions of all structures such as culverts, bridges and trestles, and mark the lines of the right of way. They supervise all of the construction as it progresses, note classification of excavations, examine and give directions as to bridge foundations, masonry, pile driving, timber framing, and all other construction work. Once each month they make an estimate of the quantities of work done by each contractor, which is the basis of the monthly payment to him.

Standards of Construction

In the office of the Chief Engineer, standard plans for the construction of all classes of excavations, em-

bankments, tracks and structures are prepared, as well as plans for structures requiring special consideration.

The standards of construction will be determined with due regard to the character of the proposed road. If the line is designed as a through line of probable heavy traffic, evidently the standards of construction will be much higher than for branches or lines of light traffic.

For new companies, the available capital will be the controlling factor in determining the character of construction standards. With such lines in the past, it has oftener been a question of whether a line could be constructed at all with the available capital, rather than what kind of a road was to be constructed.

In the case of extensions of operating roads, the standards of the operated line will be followed to secure uniformity of operating conditions, altered, of course, where experience has shown such changes to be desirable.

In either case the general condition is, that much time will be required to develop a traffic sufficient to meet the charges and expenses after the construction has been completed. Due regard for the interests of both the bondholders and the operating company usually requires that the road be put into operation for the least possible expenditure of money.

The limit, of course, is that these economies of construction must not unduly handicap the road after it has been placed in operation. To so design the location and construction that its economies do not go so far on the one hand that the cost of operation is excessive, and still conserve the interest of the original investors on the other, demands the

highest sort of engineering skill and business judgment.

Gould Extensions in Pittsburgh District

The extensions of the Gould System into the Pittsburgh District, by means of the Wabash Pittsburgh Terminal from the west on the one hand, and the extension of the Western Maryland from the east on the other, is a recent example of the great importance of availablity of capital in connection with the construction of all new railroads, including the extension of well-established large systems.

The Gould System of roads, comprising the Wabash, the Missouri Pacific, Denver & Rio Grande, Cotton Belt, International Great Northern, Texas & Pacific, and other southwestern lines, acquired control of the Wheeling & Lake Erie Railroad in 1901. This brought the system within sixty miles of Pittsburgh, the greatest tonnage-producing center in the United States. In 1902 the Western Maryland, which reached inland from tide water at Baltimore, was acquired.

The construction of the two gaps in the Pittsburgh district, and of the Western Pacific from Salt Lake City, Utah, to San Francisco, would have made this the only system in the United States under one control, extending completely across the country from the Atlantic to the Pacific Ocean.

There was enough guaranteed traffic from the Pittsburgh district, which was assured by contracts with certain steel corporations located therein, to assure a return on the money spent in constructing the two extensions into that district.

The territory to be traversed by the extensions was very rugged and, as the tonnage to be hauled was large, it required that the standards of the road should be high, particularly as to grades

and curvature. The cost of right of way and of real estate for terminal purposes within the city of Pittsburgh was necessarily very large.

The Pennsylvania, Baltimore & Ohio and the Pittsburgh & Lake Erie Railroads, theretofore had practically controlled the entire traffic of this district, and in consequence the proposed extensions of another system aroused their active opposition. The largest financial institutions of the country are heavily interested in the securities of these latter roads, and the proposed invasion of their territory by the Gould System caused them to actively oppose the plans for financing these extensions.**

In spite of the fact that the traffic for the new line was assured in advance, its amount and nature definitely known, and the further fact that the financing was based on the credit of a system which had been in operation for many years, sufficient capital was not found to complete the construction of these proposed lines, and those who had invested their money in the undertaking suffered large losses.

Expedients for Reducing Construction Cost

Savings in construction cost are effected principally by the following expedients:

(1). By employing "stiff" grades—that is, a grade having a large ratio of vertical rise to distance—the surface of the ground can be more nearly followed by the grade line than where easy

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**There is nothing reprehensible in the opposition of the operating roads, and the financiers associated with them, under the conditions related; the same policy of opposition would have been adopted by commercial or industrial corporations similarly circumstanced. The position of the roads occupying the territory, in such instances, is that the proposed invasion simply results in a duplication of existing facilities, which are adequate to meet all reasonable transportation demands of the district served.

grades are employed. The principal items affected by this expedient are Graduation and Bridging. The following illustrations will serve to show the extent to which these two items may be affected by an alteration in the maximum gradients:

A through line 170 miles in length projected through a rolling prairie country on grades of 0.4% north bound and 0.6% south bound was surveyed and the estimates for the cost of construction made thereon. The construction of the line was not undertaken for various reasons.

Two of the towns situated along this abandoned survey line, 25 miles distant from each other, conceived the idea of constructing a local branch line to better their transportation facilities. A survey over the same ground as that occupied by the through line was made, using gradients of 1.5% in both directions.

The estimated cost on the through line for grading per mile was $4,215 and for bridging $1,470. On the local branch line, the estimated costs were, for grading $1,400 and for bridging $400, the larger part of the difference in cost being attributable to the saving effected by the use of the stiffer grade, a smaller part being accounted for by the difference in area of the proposed cross-section of excavations and embankments.

In a very hilly country a survey was made to determine the relative economy of making the controlling gradient 0.3% in both directions on the one hand, or 0.4% north bound and 0.6% south bound on the other. The estimated cost of the line using the 0.3% gradient was $63,800 per mile; of the 0.4%-0.6% line $54,600 per mile, the cost of the equipment not being included in either case.

(2). In prairie or comparatively flat country, the employment of curvature will not usually effect a

saving of any great amount. In a hilly or mountainous country, however, curvature may be employed to effect a very considerable saving in construction cost.

Where the grade line of a railroad is supported between the ridge at the top and the valleys at the bottom, in passing from one valley over a ridge into the other, it frequently is located on steep slopes and the turns are in many cases very abrupt. This necessitates sharp curvature to avoid expensive grading.

On many railroads, if the grade line is to approximate the contour of the surface, a large number of sharp curves are absolutely essential, even on the most important of trunk lines, to make the construction of the line economically possible. For branch lines traversing such districts, where the anticipated traffic is not large, many of them can not be considered at all, unless extremely sharp curves, and a large number of them, are used.

(3). The cost of the construction will be affected, to a considerable extent, by the widths of the finished excavations and embankments. During much of the earlier construction, the standards were usually about as follows:

In earth excavation, 16 ft. base, with slopes of 1:1—that is, 1 foot horizontal to each foot vertical depth.

In rock excavation, 14 ft. base, slopes ¼ to 1.

On embankments, 14 ft. base, slope 1½ to 1.

On important lines, the standards of construction today are usually about as follows:

In earth excavation, base 26 ft., slope 1½ to 1.

In rock excavation, base 24 ft., slope ¼ to 1.

On embankments, base 20 ft., slope 1½ to 1.

It will be readily seen from these dimensions, that the quantities of grading may be varied to a con-

siderable extent by the adoption of different standard cross-sections.

(4) Saving of cost in original construction may be made by constructing as much of the bridging as possible in a temporary manner. As to a large part of it, even where the line is of considerable importance, it is usually economical to construct temporary timber trestles, at the time of original construction, although masonry and steel structures are contemplated for the future.

On a new line the cost of transporting by wagon the sand, cement, stone, and steel required for bridges is a very large part of their total cost. A cubic yard of masonry weighs more than two tons, and wagon transportation will cost usually between thirty and fifty cents per ton-mile. Suitable sand and stone are seldom found near the bridge sites—in many instances not even in the construction district. In practically all cases cement and steel are shipped in by other railroads, and unless the line closely parallels an existing railroad the hauls are long.

The plan usually followed is to build a temporary structure of timber, replacing the timber structure with the permanent structure at the time the temporary one would otherwise be renewed. The bulky materials of the permanent structure may then be hauled by train to the bridge site at a cost of about ½ cent per ton-mile. The cost of using timber piers under 100-foot spans, of moderate height, is about 35% of the cost of masonry piers.

A comparison of vitrified tile pipe with cast iron pipe, for small culverts, shows comparative costs as follows:

*Comparative Cost of Pipe Lineal Foot

Diameter of Pipe.	Cast Iron.	Vitrified Tile.
12″	$1.31	$0.75
18″	2.92	1.10
24″	4.37	1.45
30″	5.83	2.00
36″	7.87	3.75

It will be seen from this that very considerable saving may be made by employing temporary structures in the original construction of bridges and culverts.

(5). Ordinarily, on new lines, all of the buildings, such as passenger stations, freight sheds, engine houses, machine shops, and store rooms, are frame structures of cheap construction, and the fewest number possible to conduct the business are built.

(6). As the traffic for new lines is usually light for the years immediately following the construction, a comparatively light track is used.

In the case of the extension of operated lines, it is customary to use what is termed "relayer" rail, that is, rail which has been used in the main line and has become too much worn for that class of traffic, but which is good enough for use on lines of less traffic. One particular purpose in using this "relayer" rail is to avoid the "kinking" of new rail, as all of the grading will be undergoing a process of shrinkage and settlement during the eight years (usually) following the construction of the road.

(7). In the matter of sidings at local stations and of passing tracks for the operation of single track lines, the business being light and the trains

*Cost affected by length of haul.

in consequence few, the construction will be limited to bare necessities.

(8). Unless the constructed line is a very important one, and will carry a large traffic immediately after its construction, the track is ballasted with earth from the side of the track.

Ballast placed upon a new grade undergoing the shrinkage heretofore mentioned, will disappear in a short time within the embankments upon which it is placed. It is therefore not economical to place expensive stone or gravel ballast on new roads for at least three or four years after their completion.

(9). In the matter of road crossings, that is, the crossing of the line of the railway by public highways and private roads, the traffic on newly constructed roads being light and the trains in consequence comparatively infrequent, the danger of accidents at such crossings is very much less than on busy main lines. The separation of the grade of the highway from that of the railroad is generally a very expensive matter, as will be shown in the following pages, and to avoid it, crossings are made at grade wherever possible.

The same conditions exist at points where the new line crosses other railroads. Formerly railroads crossed each other at grade, or not, as they were able to make agreements with each other; for the last twenty years, however, the state commissions have in most instances compelled a separation of grades in original construction at points where railroads cross each other.

(10). On account of the infrequent train service, there will be no large expenditure for signals;*

*Moving signals; such fixed signals as "whistle," "road-crossing," etc., will be practically the same on the new as the older road. These latter are unimportant as to cost.

about the only signals required being those at telegraph stations and drawbridges.

(11). The character of the track and of the bridges heretofore mentioned, together with the light traffic, require the use of comparatively light engines, and the expenditure for equipment is in consequence much less than will be required when the traffic has grown.

(12). The yards at intermediate stations and at terminals will for the same reason—light traffic—be much smaller than the increased traffic will later demand.

All of these expedients for keeping the cost of the original construction at the minimum are justifiable from an economic standpoint. Most of the criticism of the original location and construction of the earlier periods is not justified when the actual conditions obtaining at the time of original construction are considered. It is repeated here that the availability of capital and the time required to develop the business of new lines are absolutely controlling factors in new railroad construction.

All new lines should of course be located and constructed with the view of eventual change when the traffic density has increased to the extent of justifying the additional expenditure. At points where the cost of original construction is heavy, however, it will be expedient very often to avoid the construction of tunnels and other expensive work by adopting a temporary line, using higher gradients than are controlling on other parts of the line.

While the operating expense will be increased on account of "doubling the hill" or of the pusher service required at such points, the financial conditions will generally be such as to force the adoption of the temporary line costing less to construct.

Estimates of Construction Cost

The following illustrations will serve to give the comparative costs per mile of newly constructed railroads, in districts with varying topographical characteristics:

For a proposed railroad in the rolling prairie country of the north central states, 170 miles in length, with controlling grades of .04-.06, connecting two large systems of operated railroads, the estimated costs** per mile were as follows:

(Estimate A)	Cost per mile.	Per Cent of Total.
Graduation	$ 4,129	17.7
Bridging and Culverts	920	4.0
Track	7,450	32.0
Ballast	1,500	6.4
Miscellaneous	1,569	6.7
Administration, Interest, Engineering	1,750	7.5
Real Estate	1,000	4.3
Equipment	5,000	21.4
	$23,318	100.0

The column showing the percentage of each item to the total will indicate the relative importance of any particular item.

The following estimate of cost of construction was made from surveys for a line 25 miles in length in a very hilly country in southwestern Wisconsin. The line was to be operated as a branch line of an operated road, designed to serve a city of 5,000 population and a large number of small zinc mines:

**None of these estimates include bankers' commissions and discounts, which are always a large percentage of construction costs.

(Estimate B)	Cost per Mile.
Graduation	$ 7,382
Bridging and Culverts	3,561
Track	5,782
Miscellaneous	1,568
Real Estate	2,424
Administration, Interest, Engineering	1,105
Equipment	1,963
	$23,785

It will be noted that the cost per mile of this branch line, through a hilly country, was practically the same as for the through line in a rolling prairie country. If the standards of grades, track and other construction had been the same for this branch line as for the one first estimated, the cost would probably have been between two and three times that given in Estimate B.

The following estimate of cost of construction is for a line 37 miles in length in a hilly country, designed to be operated as a through line, carrying a large traffic:

(Estimate C)	Grade 0.3%	Grade 0.4-0.6%
Distance	36.5 miles	37.0 miles
Earth Excavation base 26′-1½:1 slope		
Embankment base 20′-1½:1 slope		
Bridging-Concrete Masonry		
Track 80 lb.—ballasted		

	Grade 0.3%	Grade 0.4-0.6%
	Cost Per Mile.	
Grading	$42,363	$32,190
Bridging	4,301	5,840
Track	9,267	9,267
Minor Structures..	866	855
Terminals	2,466	2,432
Real Estate.......	1,000	1,000
Overhead Expense	3,556	3,042
	*$63,819	*$54,626

*Does not include equipment.

In comparing the estimate for the line shown in Estimate C, it should be noted that it does not include equipment, as do the preceding estimates. Note the large increase in cost which the permanent character of the construction and low grade require.

The estimated construction cost of the Kansas City, Mexico & Orient from Kansas City to the Rio Grande River in Texas, amounting in the aggregate to 1,194 miles, was as follows:

(Estimate D)	Cost Per Mile.
All items of Roadway*......	$19,526
Equipment	4,381
General Expenditure	2,793
	$26,700

*Includes real estate.

This road traversed a comparatively flat country through the states of Kansas, Oklahoma and Texas. It covers the actual costs of over 600 miles of line, with the estimated cost to complete the balance. It includes a double track belt line at Kansas City, Kansas, which has been constructed, but not as yet placed in operation. It is a fair average of the first cost of lines of its character in the southwest.

Additions to Cost of Original Construction

At the time a railroad is completed and first placed in operation, which usually begins with a few comparatively light trains, it is by no means sufficient to serve the needs of even a moderate traffic. In addition to the current maintenance and repairs of roadway and structures, there will be certain small extensions of facilities and betterments which will usually be constructed by the company without increasing the capitalization.

These additions to the cost of first construction are very apparent when a physical valuation of a railroad property is made. In ascertaining the actual cost from the records of 1,645 miles of the Northern Pacific, in the State of Washington, which was determined to be $75,458,000, it was found that $8,848,000* of the total amount had been expended since the completion of the original construction.

In comparing such estimates as those given above, which are original construction costs, with lines which have been in operation for some time, this fact must be kept in mind—that is, the increase in cost over original construction cost, which has usually been an increment made up of many small extensions and betterments constructed without additions to capital.

Contingencies of Construction

This subject has been discussed in a general way in connection with the subject of estimates in the preceding chapter. Some illustrations from actual experience will serve to show why actual costs have often largely exceeded preliminary estimates, even

*Some of this is probably due to reconstruction.

when normal percentages have been added thereto for contingencies.

In excavating the approach to a 1200-foot tunnel in the Cumberland Mountains of eastern Kentucky, the work of a large construction force extending over a period of six months was entirely lost on account of a slide from the mountain entirely filling the excavation as though it had never been made. A thin strata of soapstone, located just below the grade of the finished excavation, caused the slide of the material when a surface ditch, built high on the hillside to intercept the surface water, had furnished the means for lubricating the soapstone strata. Drilling down to grade along the center line of this tunnel approach would not have disclosed the presence of this sub-strata.

The loss occasioned by this slide was not limited to the work performed in excavating the material alone. In order to prevent further sliding the whole approach was timbered from end to end with the heaviest of timber bents and lagging. Further, the closing of the approach delayed the work on the tunnel, which latter delay lengthened the time for getting the entire line into operation.

The line of the Greenbrier extension of the Chesapeake & Ohio Railroad in West Virginia follows the steep slopes of the Greenbrier River for a distance of 100 miles. These slopes were apparently composed of loose rock and large boulders, which had fallen from the rock bluffs, standing close to the edge of the river. The excavations were what is generally termed "side hill work"—that is, the cross-section of the railroad was partly in excavation and partly in embankment.

After these excavations were completed material from these steep slopes moved down onto the road bed, on account of a clay substratum, and continued

to do so for some years after the road was placed in operation. The amount of material contained in these slides was a very large percentage of the total excavation along the line. While apparently reasonable allowances had been made in the construction estimates, based on similar construction in the same territory, the estimates were inadequate to cover this unforeseen circumstance.

There are certain contingencies which assume the dimensions of a catastrophe, such as the destruction of the road bed of an entire division of the San Pedro, Los Angeles & Salt Lake in the Rocky Mountains, immediately following its construction. While this, as a matter of fact, occurred immediately after the road had been placed in operation, it might as well have occurred during construction.

The engineers in constructing the line had laid their grade line with such data relating to previous high water as were available. The flood which caused the destruction was evidently unprecedented.

Another class of contingencies is that of accidents caused through carelessness or disobedience of instructions. The falling into the river of the immense channel span of the St. Lawrence River bridge in Canada, is an extreme example of this, as the loss was the greatest ever occasioned by a bridge accident. The falling into the river of the channel span of the Louisville & Jeffersonville Bridge, caused by faulty construction in the false work, was another example of this class of contingencies.

Unexpected increases in price of labor are not peculiar to railroad construction, but serve to vitiate many construction estimates.

What has just been said in regard to contingencies of construction is not lessened in force by the fact that the contractor for the work assumes a large share in certain classes of these contingencies,

as experience shows that if they become great, the contractor fails and the company bears the burden in the end.

Construction Organization

There are three general methods followed in constructing new railroads:

(1.) New railroad companies—those not operating existing railroads—have very generally let a contract to a Construction Company to build the line at a certain stipulated price per mile. Payment for the work is usually made in stocks and bonds of the railroad company, and such payment is made as certain specified sections, say 20, 50 or 100 miles of line are completed, ready for operation.

(2.) Another method is that of the railroad, in its corporate capacity, letting a contract direct to one or more firms of general railroad contractors.

The contracts are usually let after competitive bidding. The quantities of material shown on the engineer's profile and in his estimates are the basis of these bids. The contract usually provides unit prices for the various classes of work to be performed, such as 18c per cubic yard of earth excavation, 4c per pound for steel bridges erected.

(3.) The third method contemplates the construction of the work in greater part by the railroad company's own forces. This latter method is usually confined to branch lines, short extensions, or isolated sections of work.

The work required in railroad construction is of a varied character, consisting of earth, rock and tunnel excavation, the construction of culvert and bridge masonry and the erection of steel bridges; the framing and erecting of timber bridges, frame buildings and many other things and structures. These require different kinds of construction plants and labor, skilled and unskilled.

No one organization, even among the largest railroad contracting companies, possesses sufficient plant to construct a railroad of any considerable length within a reasonable time. From this arises the necessity for letting portions of the general contract to sub-contractors. In the main, these sub-contractors will be assigned to the particular work next stated.

It may be divided into several general classes of work; the sub-contractor will be qualified to handle one, or several of these classes:

(a) In marshy ground, where it is necessary to borrow material for embankments from the side, the work is usually performed with wheelbarrows, or by casting directly from the borrow pit into the bank, the ground itself being too soft to support the weight of teams.

(b) In dry ground where the heights of the embankments are not too great and in excavating cuts of moderate depth and hauling them into embankments, "scrapers" operated with teams are employed.

(c) Where the haul on the material from the excavation to the embankment is longer than may be economically done with scrapers, "graders" are employed to load wagons, which the long haul necessitate.

(d) The rock excavations, when they are of considerable depth, require power drills, small dump cars and track, together with derricks and other rock-handling appliances.

(e) The deeper cuts, which usually entail longer hauls on the excavated material, are generally excavated by steam shovel plants, which include small contractors' engines, cars and track.

(f) Tunnel construction requires compressor

plants and power drills together with track, and cars for transporting the material excavated.

(g) The work of building small culverts and of laying drain pipes, which do not require derricks and other plants, will be performed by small forces of men.

(h) The driving and construction of pile and frame trestles, requiring the use of pile drivers and the work of bridge carpenters, will usually be done by other contractors than those engaged on the larger and more important bridges.

(i) The work of constructing the foundations and masonry of bridge piers and abutments of the more important bridges will be assigned to contractors having such equipment as derricks, pile drivers, tugs and barges.

(j) The work of erecting the steel bridging upon these piers and abutments, and the erection and construction of the necessary false work between them requires the use of derricks, travelers and other special equipment, and this work will usually be assigned to firms engaged exclusively in it.

The general contractor, or the construction company, will generally do some portion of the work with his or its own forces, particularly the dangerous or most difficult portions of it. It (or he) will usually construct such things as track, fences, road-crossings, buildings and other minor structures.

The railroad company retains an amount—usually 15%—due on current monthly payments as a guarantee of the completion of the work under the contract. The sub-contractors above referred to are usually men or firms of comparatively small financial resources, who must be assisted financially in starting their work and often in completing their contracts. The general contractor for the railroad com-

pany, or the construction company to whom it delegates the power to construct its railroad, assumes this burden of financing the sub-contractor and managing the actual work of construction.

The construction work will be let to these sub-contractors, whether the railroad company lets a contract to a general contractor or to a construction company. In view of this, it is difficult to understand why the method of doing the work through a construction company is so severely criticised by some present day writers. In principle, there is no difference which course the company pursues, and as to abuses, they may as well occur under the one as under the other plan.

That there have been abuses of the method of employing a construction company to exercise the duties of a general contractor is not disputed; in some cases the abuse has been so flagrant as to constitute absolute fraud, and the same may be said of the alternative plan. What it is meant to emphasize here is, that the employment of a construction company in the construction of a new railroad is not evidence of fraud or bad faith on the part of the railroad company, or the promoters of a railroad enterprise. This impression might readily be gained by reading many publications discussing this subject.

Financial Difficulties in Early Operation

The ten-year period immediately following the construction of a road, particularly in an undeveloped territory, is a trying one from the standpoint of the operating department and the financial management.

The operating expense is very much above the normal expense of older roads, on account of the settlement of the new embankments and the sliding

in of the slopes of the new excavations. The settlement of embankments and the closing of ditches in the cuts, make "soft" track, which in turn increases the cost of conducting transportation, through the slow schedules and delays occasioned by the condition of the track.

The lack of accurate data in regard to the area of waterways required at bridges and culverts will have been responsible, in a few instances, for their construction with less area than the conditions require. In consequence there will be "washouts" along the line, necessitating unusual maintenance-of-way expenditure and increased cost for maintaining the train service.

It is during this period that the revenues of the company are the minimum. While the country may be developing rapidly on account of the new transportation facilities, a sufficient period of time has not elapsed to create even a moderate traffic for the railroad. In addition, there is practically no "through" business, the traffic being confined to the local business of the line.

At the end of the first eight or ten-year period the larger part of the ties will need renewing, as that is about the average life of a tie. On account of the settlement of the embankments and of the "soft" cuts, the rail will have become badly "surface kinked," and be unfit for passenger train service and expensive to maintain for any service whatever. The temporary wooden bridges and trestles will require an abnormal amount of replacement work.

The combination of operating revenues at a minimum, of operating expenses at a maximum, and of poor credit in consequence, has very often caused the financial collapse of the railroad at this time, even though the enterprise may have been well con-

ceived (as to eventual earning capacity) and skillfully managed during the period of development.

The difficulties of new railroads here related are not abnormal ones; they are the usual and normal conditions surrounding a railroad newly constructed. Even in those few instances where the traffic seems ready in advance of actual construction, it requires time to adjust traffic to a new line of transportation.

For these reasons, many of the original railroads have been foreclosed by the bondholders and the property bought in by other railroads or new corporations, at a price very much below what it had cost to construct them. The prices paid for these railroads bore no relation whatever to cost or the value of the physical property. In all instances they were based on what the purchaser supposed their earning capacity to be when operated as transportation facilities. All of our present systems of railroads are made up, in large part, of original short lines acquired in this way.

Prior to 1870 the maximum length of a line for efficient operation was generally 100 miles. The Pennsylvania Railroad in the 50's had 500 miles; the New York Central between New York and Buffalo, formed by consolidating some fourteen companies, was, in 1858, about 500 miles long; the Chicago & North Western had over 500 miles in 1866. Between 1870 and 1890 the maximum system had grown to approximately 5,000 miles. Between 1890 and 1900 single systems aggregating 10,000 miles of line were organized.

The following table, from Ripley's "Railroads—Finance and Organization," shows the number of roads over 1,000 miles in length at various periods:

	Number.	Per Cent of U. S. Mileage
1867	1	7
1877	11	20
1887	28	44
1896	44	57
1900	48	60
1910	54	67

Effect of Combination of Railroads on Density of Traffic

The effect of combination of railroads on the density of traffic is very marked. The following simple illustration will serve to show the reason for this:

In the figure, let the horizontal line B represent a railroad 100 miles long, not connected with any other railroad, having stations at five-mile intervals, or 21 stations in all. If each station on this line interchanges traffic with each of the other stations, there will be a total of 210 station interchanges of traffic.

Let the line A represent a similar railroad as that described for B. If railroad A and B were connected up, the total station interchanges would be much larger than the sum of A and B interchanges when operated alone. The interchange when connected up would be:

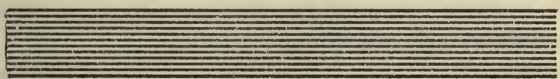
Interchanges between points on B....	210
Interchanges between points on A....	210
Interchanges between points on A and points on B (21X21).........	441
	861

That is, by doubling the mileage, in combining the two single 100 miles of line into one line of 200

miles, we have increased the number of station interchanges to such an extent that they are more than four times that of the 100-mile line.

Station Interchange
Line B Alone
100 Miles

Station Interchange
Line A, B & C
300 Miles



If still another 100-mile line C is added to these two, making a single line of 300 miles, the station interchanges will be:

Between Line A and B as above.....	861
Between Line A and C..............	861
Between Line B and C..............	861
	2583

The 300-mile line is only three times as long as the original 100 mile line, but the number of station interchanges is more than twelve times as large.

If the amount of traffic were directly proportional to the number of possible station interchanges, the figure showing "Station Interchange" would illustrate graphically the increased traffic density due to the combination of the three 100-mile lines into one 300-mile system.

While traffic density does not increase directly with the possible station interchanges, it does increase in relation to it. This is the true explanation of the cause of increased density on main lines, which is due to the constantly increasing areas served by the railroad, through extension into new territory and combination of existing railroads.

Effect of Traffic Density on Operating Expense

The combination of many theretofore independent short lines into small systems concentrated the traffic on certain lines, which required a large increase in the number of trains required to handle it. This had a most important effect on the operation of such lines.

It will be remembered that when first constructed every possible expedient was used to reduce the first cost of construction to a minimum, which meant increasing distance, using large amounts of curva-

ture and stiff grades, when these were necessary to secure cheap construction work.

While the traffic of the line remained light, the increased distance, curvature and stiff grades did not affect the operating expenses very seriously. With the number of trains increased, however, these physical factors affected operating conditions very materially, even to the extent of limiting the total carrying capacity of the line (as compared with a line not having these disadvantages).

Effect of Distance, Curvature, and Grades on Operating Expense

In connection with the location and reconstruction of railroads, engineers have determined the effect that distance, curvature, and grades have on operating expenses.

For additional distances, measured in miles, on the basis of an operating cost of $1.76 per train-mile—the average for the United States in 1914—the added annual cost per mile for each train round trip is $642. If there are 30 trains each way per day, the total annual savings in operating expense that may be made, if the distance is reduced one mile, is then $19,260.

Each degree of curvature on the railroad will increase the operating expense ninety-five cents, annually, for each train round trip. If there are thirty trains each way per day the annual saving that may be made by eliminating one degree of curvature is $28.50.

The grades of a railroad are of two kinds:

Ruling grades are those which limit the tonnage or length of train which may be hauled by a given engine. Minor grades are those that do not limit the tonnage or length of train which may be hauled,

but involve the lifting of the tonnage over elevations.

Ruling grades have greater effect on operating expense than any other one of the physical factors involved. The receipts being a certain fixed sum, the cost of handling the traffic will be very nearly proportional to the number of trains required to handle it.

Roads of light traffic and branch roads do not usually have a sufficient volume of traffic to be seriously affected by ruling grades. The passenger traffic is not generally affected, the high speed of the service demanding high steaming capacity to haul even light loads. The effect of the ruling gradient is usually confined to limiting the velocity of the train. Local freight trains usually are sent out with many fewer cars than the engine can haul and are therefore not affected by ruling grades.

The traffic in bulky freight, such as ore, coal, timber, and all other car-load freight that is handled in through trains, which are made as heavy as the grades will permit, is the portion of the traffic which is affected by the ruling grade.

The revenue derived from moving this traffic is fixed. The cost of a train-mile is nearly constant. If the grade is reduced, any given engine can haul a larger number of cars in a single train and the gross amount of the through freight tonnage can be handled by fewer trains.

A Mikado engine weighing a total of 405,500 pounds, having 196,000 pounds on its drivers, will have a tractive power of 49,000 pounds. When moving slowly up a 0.6% grade, the total resistance to traction is 18 pounds per ton of load drawn. Dividing 49,000 pounds by 18 pounds, we have 2,722 tons as the gross train load the engine can haul. Deducting the total weight of engine and tender, 202 tons, leaves 2,520 tons as the net load the Mikado

can haul slowly up a 0.6% grade. In the same manner the net load which the same engine can haul up a 1.0% grade will be found to be 1,683 tons.

Dividing the 1,683 net tons by the 2,520 net tons shows that it will only require two-thirds as many engines of equal tractive power to haul a given tonnage up a 0.6% grade as up the 1.0% grade, or, stated differently, two engines will haul on a 0.6% grade as large a tonnage as three engines will haul up a 1.0% grade. ($1683 \times 3 = 5049$—$2520 \times 2 = 5040$)

To ascertain the saving that can be effected by operating two daily trains instead of three, an analysis of the operating cost is necessary. This shows that the effect on operating expenses of operating one additional train is $33\frac{1}{3}$% of the normal average cost.

The average cost of a train-mile being $1.76, and the cost of operating an additional train being one-third of the average cost, the saving effected by using one less train is one-third of $1.76 equals 59 cents. The annual saving in operating expense for operating one less **round trip train would be per mile of road:**

59 cents per train mile × 2 trips × 365=$430.70.

If the division is 100 miles long, the annual saving would be $43,070 for each train saved.

If the total tonnage was 5,040 tons—the load that could be hauled by two engines on the 0.6% grade—then the annual saving would be the amount saved by operating one less train. If the total tonnage to be moved were double or 10,080 tons—the capacity of four engines on the 0.6% grade—then the annual saving would be the amount saved by operating two less trains, or $86,140.

It must be remembered, to avoid confusion, that this is the saving effected by reducing the controlling grade so that the **number** of **trains** required to

move a given tonnage is less. This is a different matter from the next mentioned, which concerns what it costs to **lift a train over a hill.**

The effect of grades on operating expense is: For controlling grades (maximum grades), the increased cost of operation on account of each foot of difference in elevation (rise plus fall divided by 2) is $3.74 annually, for each train round trip. For minor grades it is $2.81 per foot.

Increased Interest Charge v. Decreased Operating Expense

In order to shorten the distance, eliminate curvature, and reduce controlling grades so that heavier trains may be moved, it is necessary to expend certain sums of money in re-constructing the road. Interest must be paid on this money, and in order to know whether the expenditure is wise, the additional annual interest charge on the new capital required must be compared with the amount of operating expense that may be saved by operating over the improved road.

Application of Principles

The following illustration will serve to show the application of these principles to the solution of a definite proposition.

One of the larger railroad systems had reconstructed its line from Chicago to the southern Illinois coal fields on a basis of 0.3% grade north and 0.5% grade south bound. A section of the line 70 miles in length, from the coal field south to the Ohio River, had not been reconstructed and from the nature of its curvature and ruling grades its cost of operation was high. The line had 9 degree curves, with a total of 2,954 degrees of curvature and ruling grades in both directions of 1.3%.

The operation consisted of three daily passenger trains each way per day, one local freight and two through freight trains. A proposed new connection on the 70-mile section promised a large increase of through northbound tonnage, consisting principally of such commodities as pig iron, lumber and phosphate rock. This additional, with the existing tonnage, required the movement of 9,000 tons per day of **through** north bound traffic.

A survey of the 70-mile section developed the fact that the ruling grades could be reduced to the standards established north of the coal fields, by using one pusher grade 8 miles long at one summit, for a total cost of $2,300,000. These definite conditions necessitated the solving of the problem of whether the fixed annual charge for interest on the cost of improving the line would be greater or less than the saving in operating expense which the improvement would effect.

As the northbound tonnage exceeded the southbound, the northbound grade was the ruling grade. The northbound grade was 0.3%. The new line reduced the distance 1.6 miles; the curvature 2,074 degrees and the rise and fall in the grade line 280 feet.

The total through freight to be hauled was 9,000 tons. The Mikado locomotive heretofore mentioned, with a total weight of 405,500 pounds, has a tractive power of 49,000 pounds. The total train resistance on a 1.3% grade is 32 pounds per ton of train. Dividing 49,000 by 32 gives 1,531 tons as the gross load the engine can haul. Subtracting the total weight of the engine, 203 tons, leaves 1,328 tons as the net load of cars and lading. Assuming the weight of the empty cars as one-third of the total weight, the tons of **freight** that can be hauled will be:

$$1{,}328 \text{ tons less } \tfrac{1328}{3} = 896 \text{ tons.}$$

Dividing the total through tonnage to be moved, 9,000, by 896 tons per train, gives 10, which is the number of daily trains that would be required to move the tonnage on a 1.3% grade.

Using the same engine on a 0.3% grade, it will be found that only 4 trains will be required to move the 9,000 tons. Two such engines (the road and the pusher engine) will move the tonnage up the pusher grade.

The factors heretofore given when applied to the number of trains saved by reducing the ruling grade; to the number of degrees of curvature eliminated; to the distance shortened; to the reduction in the rise and fall of the grade line, will indicate the annual saving in operating expense which the improvement in these operating factors will effect.

Summarizing these different annual savings, we have:

Reducing ruling grade.....	$164,894
Reducing curvature	27,584
Reducing distance	14,380
Reducing rise and fall......	14,660
Total annual saving in operating expense......	$221,518

The cost of the improvement, as before stated, was $2,300,000, which at 5% interest would make an increased annual interest charge of $115,000. The annual profit to the railroad in making the improvement is therefore $221,518, annual saving in operating expense, less $115,000 increase in fixed charge (interest), which is $106,518.

When the traffic density of a line has increased considerably, such questions as the one involved in the illustration will come up for solution. The analysis of them is always from an economic standpoint, the possible saving in operating expense being com-

pared with the increased interest charge on the new capital required to make the improvement in the operating physical factors of distance, curvature, and grade. Whenever the saving exceeds by a considerable amount the increased interest charge, the improvement will be undertaken, if money at reasonable rates of interest is available for the purpose.

In this connection it must be noted that the possible saving in operating expense, by improving the grades and other factors, increases directly with the number of trains. It follows that what might be a good investment in improving the line if ten daily trains were run, would be ill advised and unwarranted from an economic standpoint if only five were run. It is the **increased traffic density** which makes the net saving in cost of moving the traffic possible.

Reconstruction

The conditions attending the reconstruction of railroads were very different from those that existed at the time of their original construction. Economy in operation rather than available capital was the controlling factor. It must be remembered, however, that this last sentence applies to roads whose reconstruction assured very large and immediate returns on the cost of the improvement, as for instance, the Lucin Cut-Off of the Union Pacific, which effected an annual saving of $1,000,000 in operating expense by the expenditure of $10,000,000 for reconstruction. There are many railroads operating today which might be reconstructed, from an economic standpoint, if the capital for the improvement were available at a reasonable rate of interest—say five per cent per annum, with no discount on the securities issued to provide for the improvement.

The financing of the reconstruction had the benefit of a credit based on the accomplishments of a going concern, whose past earnings were known. Further, the minimum available traffic on which to base the calculation for possible operating economies was definitely known, and, in consequence, the justifiable expenditure for reconstruction could be stated with reasonable certainty.

Changes in Character of Road, Structures and Equipment

This reconstruction altered the **character** of the original roads in many important particulars, both as to their roadbed and equipment. The most important changes are stated in the following paragraphs:

(a) The most important single feature of the reconstruction, both as to cost of the improvement and of the effect on operating expense was the reduction of the ruling gradient of the road, for the purpose of increasing the tonnage which could be hauled in one train.

(b) The increased length of train, made possible by reduction in the ruling gradient, necessitated the reduction of curvature, both as to amount and to the **sharpness** of curves, on account of their effect on such longer trains.

(c) To reduce the gradients and curvature, with the expenditure of the least possible amount of money for reconstruction, often necessitated an entirely new location of the line at certain points. This required the purchase of a new right of way at very much higher unit prices than was paid for the original line, it having served to develop and thus increase the value of property in the entire district traversed. An illustration of the amount

of this increase is shown by the two following instances:

In the construction of a line in Southern Illinois near a county seat town, the railroad was compelled to take a parallel strip of land for a distance of about one-half a mile through a growing orchard; the cost for this additional land exceeded $5,000 per acre.** In the reconstruction of the L. & N. R. R., near Nashville, Tenn., through property whose normal value was perhaps $200 to $300 per acre, the cost of a parallel strip of land exceeded $4,000 per acre.

The reason for this large increase in unit price per acre for land required for reconstruction is probably found in the fact that some authorities hold that a railroad company exhausts its right of condemnation when it acquires its original right of way; hence individual bargaining, rather than condemnation proceedings, must be resorted to in the acquirement of real estate for reconstruction purposes. Whether this latter proposition is legally sound or not, there is no question as to the cost of real estate for reconstruction purposes being many times greater than the current market price of land adjoining it.

(d) When the reconstruction of the line does not involve a new location, it is necessary to construct temporary tracks to carry the traffic while the reconstruction work is being prosecuted. As reconstruction work is confined to lines of comparatively heavy traffic, these temporary tracks must of necessity be of substantial construction, and, in consequence, add much to the cost of reconstructing the line.

(e) In order to effect economies in the maintenance of the roadbed, and to prevent the loss of

**A mile of right of way, of the usual width, would cost $60,000 on this basis of land value.

expensive ballast, which the heavy traffic requires, the cross-sectional areas of excavations and embankments is very much increased over that of the original construction.

Reduction of the grade deepens excavations, making them longer, which increases the length of the hauls on the materials from the excavations into the embankments. The longer hauls, in turn, increase the cost per yard of material excavated. That is, **both** the **quantity** of material and the **price** per unit, is very much increased in reconstruction work over that of the original construction.

(f) As the life of untreated timber trestles and other timber structures in the roadbed is, as an average, only ten years, the annual cost of maintaining such structures is comparatively high. The cost of masonry is very much less when the transportation cost of its constituent materials is reduced. As heretofore stated, the cost of transporting such material by wagons is about forty cents per ton-mile, while its cost in railroad cars is less than one-half cent per ton-mile. It is evident from this, that in many situations, it will be economical to use masonry structures in a reconstructed line, while it would be the reverse of economical to use them in original construction.

For this reason, in practically all reconstruction work, the temporary structures are replaced by permanent structures of masonry and steel or reinforced concrete. This replacement, as shown, is economical in itself, but it increases the capital expenditure to a very large extent. Comparisons between the costs of temporary timber structures and of various permanent structures to replace them are shown in the following:

The average cost of trestles on the Santa Fe in Illinois for 1910, using untreated timber, was $11.20

per lineal foot for open-deck trestles; for timber trestles with ballasted floors, the cost was $16.20; the cost of concrete trestles varies between $20 and $25 per lineal foot.

A temporary trestle, constructed for the purpose of carrying a public highway under the roadbed, where the height of the embankment is 20 feet, would cost something less than $1,400; the cost of a reinforced concrete underpass, to replace such temporary timber structure, would be $5,800, or about four times the cost of the temporary structure. The difference in cost between timber and masonry piers for girder span bridges is approximately as $10 is to $28, per lineal foot of bridge.

(g) The weight, and consequently the cost, of the steel bridges has increased rapidly, as the increase in density of traffic requires heavier engines. The weight of the steel structures is, of course, proportional* to the weight of the equipment, which it carries. The following statement, taken from Gillette's "Cost Data," shows the increase in weight of locomotives on the B. & O. R. R. between 1835 and 1895:

	Weight in Tons.
1835	10.7
1851	37.3
1863	45.4
1873	52.6
1881	54.3
1886	56.6
1890	66.5
1894	80.4
1895	95.0

A Mikado engine, a not uncommon modern type, weighs approximately 200 tons—total of engine and tender.

*Not directly proportional.

The Kinzua Viaduct, a steel structure, constructed on the Erie R. R. in 1882, weighed 1,400 tons. The weight of the viaduct which replaced it in 1910 was 3,350 tons, or more than double the weight of the original structure. This is a typical, rather than an isolated case of increase in weights of bridges.

(h) The timber culverts and tile pipes of the original construction are, in most instances, replaced with cast iron pipe in reconstruction. The difference between the cost of a 36-inch vitrified tile pipe and of a cast iron pipe, under an embankment 20 feet high, is as $300 is to $630.

(i) The frame depots of the original construction will generally be replaced with brick passenger stations, having brick or concrete platforms and some type of permanent construction for the freight houses. The cost of the original frame stations was usually between 12c and 15c per cubic foot; the cost of the permanent structures which replace them, will seldom be less than 25c per cubic foot, and sometimes considerably higher than this. The size of the building will usually be increased, as well as the unit price.

(j) The cost per mile of track, using 60-lb.* rail, not including ballast, is $7,500; the cost of track, using an 85-lb rail, without ballast, is $9,650. A great many of the railroads were originally constructed with 56-lb and 60-lb rail, and in some instances even lighter than this. On any important main line, the rail is seldom less than 85-lb. rail, and in some instances exceeds 100-lb.

The more frequent train service, made necessary by denser traffic, necessitates the location of passing

*60-lb. rail means that one yard, or three feet, of the rail weighs 60 lbs. The cost of the rail is directly proportional to this weight, although the cost of track of 60-lb. rail is not directly proportional to one of 85-lb. rail, as there are some items, such as ties, which are common to both. In the 85-lb. track cost of improved joints and tie plates is included.

tracks at shorter intervals than are required for the lighter traffic of the original line. Passing tracks are very often located at intervals of ten miles on original construction, with the idea of placing intermediate tracks at five-mile intervals when increased traffic demands it. These will usually be built at the time the road is reconstructed.

In many situations, particularly at points where railroads cross each other, and at the entrance into busy freight yards, the crossings and switches, which replace those first laid, are constructed of manganese steel, the cost of which is usually four times that of the original construction.

The heavier traffic of the reconstructed line requires ballast of rock, chats, or gravel. Even when the road theretofore has been ballasted, a "raise" of four inches or more of new ballast will be required. The cost per mile of twelve inches of rock ballast will usually be about $3,900.*

It will be noted from these items, that the cost of the track in reconstruction is very much higher than the track of the original construction.

(k) The chance for accidents at railroad crossings increases with the increase in number of trains. Road crossings which may be operated in comparative safety when the line carries only a light traffic, become dangerous as the number of trains increase.

The authorities, both state and municipal, have of late years insisted on the separation of the grade of the highways from that of the railway at these crossings, and this has necessitated an expenditure of very large sums of money on the part of the railroads in constructing new crossings over or under the operated lines. The requirements, as to grade and width of the approaches to these required cross-

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*On basis of 60 cents for stone and 40 cents for labor inserting and surfacing, making a total cost of $1 per cubic yard in place.

ings, are much more rigid than obtained at the time of the original construction. This involves a very much larger expenditure in the construction of considerable embankments and, in most cases, the acquirement of additional land upon which to construct the new road approaches.

As an instance of the amount of money involved in such changes of road crossings, the reconstruction of 36 miles of line in northern Indiana required the abolishment of 54 grade crossings. The estimated cost of separating the grade of the crossings from that of the railroad was $293,500. This amount, for the 36 miles of reconstruction, added $8,150 per mile to the cost of the reconstructed line.

*The cost of crossing a double track railroad with an overhead roadway 20 feet wide on the approaches, and 16 feet wide on the overhead bridge, at current prices, is approximately $7,900, without allowance for additional real estate or damage to abutting property on account of the construction.

(l) What has just been said in regard to the crossing of public highways, applies as well to the crossings of other railroads, the cost of the latter, however, being very much greater than the former.

Usually the work is not confined to the line under reconstruction, but extends as well to the line of the railroad which it crosses, for a considerable distance on each side of the crossing. When the crossings occur in a district like that at Grand Crossing, just south of Chicago, the cost is measured in millions of dollars, and even under the most favorable conditions the cost is a considerable amount.

(m) Most of the reconstructed lines, at least those of recent years, have adopted a system of automatic signals to protect the train service. The cost of such a system, using direct current, is from

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*When adjoining land is the same elevation as the track.

$1,500 to $1,800 per mile; for alternating current, $1,800 to $2,000 per mile. Inasmuch as the cost of maintenance on the latter is about one-half that of the former, the alternating current is being very generally adopted. These figures are based on a system of circuits with one mile blocks.

(n) The cost of the reconstruction is very much increased when the traffic is such as to require a second track, the amount of the increase depending on the character of the country, in which the line is located. In a very hilly or mountainous country, where the line lies largely on the slopes of steep hills, or in rock bluffs, the cost of the second track alone will, in some instances, exceed the cost of grading the original line.

(o) The capacity of the yards at the terminals of a line must, in consequence of all the foregoing, be very greatly increased to avoid serious blockades. On account of the very large expenditures required for obtaining the necessary real estate at important terminals, this matter has in many cases been deferred, as far as possible, and is today one of the most serious operating problems of the railroad companies.

Even in small places the cost of increasing terminal or yard facilities is necessarily high, and adds materially to the cost per mile of reconstruction.

(p) As the density of the traffic increases, heavier engines are more economical in operation than the former lighter engines. The cost of light passenger engines formerly had been from $6,000 to $10,000 for the American type. The heavier engines of the Atlantic and Pacific type now cost from $17,000 to $18,500; the Mogul engines heretofore in use, costing $8,000, have been in many instances replaced by Consolidation and Mikado engines costing $19,000. It is evident from this that

there has been a very large increase in the expenditure for motive power, caused by the increased density of traffic.

The use of the larger engines has required the reconstruction of the engine houses, and in such reconstruction permanent structures have replaced the temporary ones of the first line. A modern engine house, as now constructed, costs $3,500 per stall; the older engine houses, of temporary construction, cost about $1,500 per stall.

The turn tables, at division and terminal points, have been replaced on account of this increase in size of engines. A 70-foot turn table costs practically $7,000; a modern 90-foot turn table costs $13,100.

(q) Freight cars have also been improved, as a result of increased business and of more economical design. The ratio of the weight of a freight car to its carrying capacity has a very important effect on operating economy.

In 1885 the standard box cars weighed 24,800 lbs. and had a carrying capacity of 50,000 lbs., or two times the weight of the car. At this time 60,000, 80,000 and 100,000 lbs. capacity cars are standards for various classes of service. The weight of a 100,000 lb. capacity car is 38,500 lbs., and its carrying capacity therefore 2.6 times its weight.

To handle such cars in long trains safely, requires the use of improved couplers and air brakes. In 1889 less than 12% of the cars and locomotives in use were equipped with air brakes; at the present time practically all of them are so equipped. In 1889 less than 8 per cent of the cars were equipped with automatic couplers; practically all cars are now so equipped.

While the use of cars of high carrying capacity is economical, the increased cost of such equipment

has added very materially to the capitalization of the railroads.

Estimates of Cost of Reconstruction

The following estimated costs per mile* for reconstructed roads may be of interest in this connection:

In reducing the controlling grade on 61 miles of railroad from 1.3% to 0.3-0.5% the costs were as follows:

	Per mile.
Grading	$22,178
Bridging	3,502
Track	7,801
Minor Structures	1,018
Real Estate, Engineering, General Expenditure	3,368
	$37,867

It must be understood that not all of the 61 miles of line was affected by the reconstruction. On certain portions the original grades were well below the proposed controlling grade, the work being confined to those points where the original grade exceeded the proposed controlling grade, or excessive curvature required elimination.

The reconstruction cost of 34 miles of line in the flat country of northern Indiana, the controlling grade being reduced from 0.5% to 0.2%, was $47,000 per mile of line.

Increased Capitalization Due to Reconstruction

It is evident that a very substantial increase in the capitalization of the railroads has been neces-

*None of these estimates include cost of equipment or bankers' commissions and discounts.

sary to cover the cost of the reconstruction of the road bed and the improvement of the equipment. This analysis by items explains the increase in the average capitalization per mile of railroads in the United States since original construction.

Prior to 1906 the capital actually employed in transportation was not separated from "securities owned" in statements of railroad capitalization. Since that time the Interstate Commerce Commission has required this division of capital account. For this reason figures for comparative purposes are not available for years prior to 1906. The following table shows the net capitalization of active railroads in the United States, per mile of line:

1906	$52,050
1907	58,200
1908	57,200
1909	59,200
1910	62,600
1911	63,900
1912	63,500
1913	65,900
1914	66,661

This table reflects the effect on capitalization of this reconstruction period. It must be remembered that this increase is due to this reconstruction and not to arbitrary increases in capital, as many writers and critics of the railroads have assumed.

The work of comprehensive reconstruction has applied only to important main lines and lines having a very large tonnage. Had all of the lines been reconstructed in the manner heretofore described the capitalization would have been much more than doubled.

Constant Reconstruction

Railroads are in constant course of rebuilding, improving and extending their facilities. In this connection, the testimony of Mr. E. P. Ripley, President of the A. T. & S. F., in the hearing of the Interstate Commerce Commission, in 1910, relating to rates between Chicago and the Rocky Mountains, is interesting.

In answer to the question of the Examiner of the Commission as to whether the western roads "had been built round about 50 years," he replied:

"Yes sir. Some of them longer, but they have been in constant course of rebuilding ever since they were constructed. The railroad of 50 years ago would not carry anything now and the railroad of 50 years ago would not be considered even equal to a contractor's plant for building a railroad. They have been in constant course of rebuilding ever since, and that has been going on indefinitely."

He further stated that within his recollection the A. T. & S. F. has been rebuilt three times.

The President of the Baltimore & Ohio R. R., Mr. Daniel Willard, made a statement, at a meeting of the members of the headquarters staff of that system, that during the five-year period, 1910-1915, $100,000,000 had been expended on the system for betterments, and that about $50,000,000 of the amount had been expended for additional tracks, terminals and grade reductions.

The same thing is true of every one of the large systems. Combinations of smaller roads into systems have concentrated traffic along certain lines and general routes, requiring their reconstruction. These first smaller systems have been combined into larger systems, and still greater concentration of traffic has required further reconstruction, the construction of second tracks (in several instances of

six tracks), and an enormous expanding of yards, terminals and other facilities.

The modern railroad is as far superior to the railroad of 40 or 50 years ago as the first railroads were to the old turnpikes. This fact must be constanly kept in mind in considering the subject of railroad capitalization, physical value and the related subject of railroad rates.

Summary of Construction and Reconstruction Periods

The following is a fair summary of conditions and the important facts relating to the Construction and Reconstruction of the railroads:

(1) The availability of capital has been the controlling factor in determining the character of the construction of new lines. In the original construction many temporary structures were built to reduce the original expenditure. The various expedients for reducing capital cost were justified by the difficulty encountered in securing capital, and the certainty of the volume of traffic being small for a considerable period next following construction.

These conditions as to capital have applied not only to small roads, and to the earliest periods of construction, but to large systems and to comparatively recent times, as exemplified in the experience of the Gould System in its extensions into the Pittsburgh District and to the Pacific Coast.

(2) In addition to the current maintenance of roadway and structures, the forces of the railroad companies, and its contractors, have constructed extensions of facilities and betterments out of earnings, without increase of capitalization. Actual valuations of large systems have shown that these uncapitalized additions form a very considerable percentage of the original cost of construction.

(3) Contingencies are incident to construction. Many of them in actual work have been so great as to constitute catastrophes, causing the loss of all capital invested. In all construction, large additions to estimates must be made to provide for them, but the records of most construction work have shown, that even when seemingly sufficient additions have been made—based on previous experience in similar work—they are generally insufficient to cover the actual conditions.

(4) The construction of a railroad involves many different classes of work and a very large plant, composed of many varying kind of tools and machinery. It is not expedient for a railroad or for any firm of contractors, however large, to own a plant of sufficient size to build a railroad unaided.

The necessities of construction require the letting of the contract by a railroad to a contractor or a construction company, and the subletting by them of much work to smaller subcontractors.

While in isolated cases abuses have grown out of the latter method of constructing railroads, such instances do not serve to show any inherent fault in the method of constructing new railroads through a construction company. Either that, or some equivalent expedient, is absolutely essential. In consequence, the general condemnation of the practice of constructing work through construction companies is unwarranted, as the same abuses may and do occur when the work is performed by a contractor, or by the company with its own forces.

(5) Even in the case of well-conceived railroad enterprises, honestly built and skillfully managed, the combination of abnormally high operating expenses, low operating revenue, and the necessity for large renewals of ties, rails, and temporary bridge and other structures at the end of the first ten-year

period, has caused the financial collapse of many such enterprises. In foreclosure sales of these properties, neither the cost nor the physical value of the property has determined the price for which they have been sold, their earning capacity as transportation facilities being the basis of the price paid for them.

(6) Combination of smaller roads into systems has increased the density of traffic on certain lines. Such increase has made it possible to consider expenditure for making improvements in the physical factors of distance, curvature, and grade, for the purpose of reducing operating expense. When the saving in operating expense is greater than the interest charge on the capital required to improve the operating conditions, the improvement is generally undertaken.

(7) The conditions surrounding the reconstruction of the railroad are very different from those attending the original construction. Capital is available, as there is a certain definite traffic to be provided for by the money which is to be expended. Credit is good for the reason that reconstruction is undertaken only on account of an increased paying business, the return on the money being assured, because the work is not undertaken unless it saves more in operating expense than it costs in interest.

In consequence, the character of the improvement is very different from that of the original road, economy in operation being the controlling factor and not the capital available. All structures are of a permanent nature, the equipment of greater capacity, and the motive power of greater size and power, which means that the cost of everything on the railroad is very much increased.

It is this condition that is responsible for the larger present capitalization of reconstructed lines than ob-

tained before such reconstruction was demanded by increased density of traffic.

(8) The first reconstruction occurred when small isolated roads were formed into smaller systems. The combining of these into larger systems necessitated further improvements of lines theretofore reconstructed, that is, some lines have been reconstructed in whole or in part more than once, and the process will continue so long as the business of the country progresses and the transportation facilities are kept abreast of it.

CAPITALIZATION

Functions of Transportation Companies

A Railroad Company has three separate and distinct functions in transporting passengers and freight. It supplies:

(1) A road over which the vehicles of transportation may travel.

(2) A vehicle and the motive power to carry passengers and freight over the road.

(3) An organization to conduct transportation and to maintain the road and equipment.

This division of the work of a railroad company into its fundamental parts must be made to obtain an understanding of its financial organization.

The furnishing of a road involves the acquiring of land upon which to construct it, the excavation of cuts and tunnels, the building of embankments, the construction of bridges and culverts and of the track that is laid upon them. It must provide stations through which to receive and deliver freight, and accommodate its passengers; buildings to house its engines and cars, water and fuel stations to operate them, and shops in which to repair them; buildings to protect its tools and store supplies. It must provide means for carrying public highways, private roads and other railroads across its roadbed, and many other things of a like nature.

The money spent in providing all of these structures and things is irrevocably committed—a **permanent investment** in a transportation facility that is to be operated as long as transportation is required—that is in perpetuity, as far as we now know. The term of a bond, which is an evidence of such an investment, may therefore, with safety be a long

period of time. In the United States it is usually from 30 to 100 years.

The furnishing of a vehicle and the motive power requires the providing of locomotives, passenger and freight cars and such floating equipment as transfer barges, boats and tugs. The money spent in providing this road and floating equipment is an investment, the life of which should not exceed the years of useful service of the equipment for which the money is expended.

If the useful life of the engine or car is 20 years or 25 years and it then, through use, depreciation or obsolescence, is no longer serviceable in transportation, the term of the bond (or equipment trust certificate) which is the evidence of the investment, should not exceed 20 or 25 years, and the safety of the investment demands that it shall be considerably less. It is usually from 10 to 15 years in this country.

To furnish an organization to operate the equipment over the road and to maintain the road and the equipment, the railroad company must be allowed to collect charges sufficient in the aggregate to pay for the labor and supplies required:

(a) In conducting such transportation;

(b) In repairing and maintaining the roadbed, structures and equipment, and to provide for:

(c) Payment of interest on the money invested in the roadbed and equipment;

(d) A profit for the company providing the facilities and operating them.

Stockholders

The money needed to pay the cost of constructing the roadbed, structures and equipment was obtained, in the earlier periods of railroad construction, by subscription to the shares of the railroad company. The share holders were partners in the enterprise

and furnished all of the money required to provide these facilities ready for operation.

The difference between the shareholders of a railroad and of partners in an ordinary business enterprise is that the liability of the former, as to the debts of the corporation, is limited to a certain specified amount—the face value of the shares they hold.

This form of financing was simplicity itself; the holder of each share of stock contributed the same amount toward the cost of constructing the railroad and received the same proportion of the profits arising from its operation as every other holder of a similar share.

The capitalization of some very important systems is still made up in larger part of these shares of stock, but there is not a railroad in this country whose capitalization is represented entirely by shares.*

Early Financing

The first roads constructed in this country traversed comparatively thickly settled communities which had been developed industrially to a considerable extent. In consequence traffic was assured in advance of their construction, and also an immediate return on the money invested in them. The earlier operation of railroads in England had demonstrated their ability to earn a fair return on the money invested in them and such investments were therefore attended by little risk.

So long as the construction was confined to thickly settled and industrially developed districts, this mode of financing answered all of the requirements. It soon became apparent that the railroads could be employed in developing districts thinly settled and with few existing industries, and that such

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*The D. L. & W. had a funded debt of only $334 per mile in 1914.

enterprises would eventually be profitable, although the return on the investment would not be immediate.

As related in the Historical chapter, the supply of capital has always been insufficient in this country for the needs of railroad construction. Any method, then, that provided additional capital or credit that could be employed in extending existing railroads was a public benefit.

Evidently the plan of securing capital by subscription did not fully employ the credit of the railroad, for the physical property produced through the expenditure of original cash subscriptions could be used as security in borrowing money for extensions or betterments of the property.

Bonds

Borrowing by railroads in their corporate capacity had its source in the following conditions, which were found to be incident to railroad construction and operation:

(1) The final cost of railroads, through the contingencies attending the construction of the work, exceeded the estimates of cost on which the original financing was based.

(2) The temporary construction, (necessitated by the limited capital available and the high cost of permanent construction in districts remote from other transportation facilities at the time of original construction) had to be replaced by permanent structures when the traffic density of the line increased to an extent justifying the necessary expenditure.

(3) After the railroad was completed and ready for operation, it needed a cash working capital with which to conduct its business, which necessity, often, had not been provided for in the original financing.

To provide for these necessities, money was borrowed and the loan secured by a mortgage on the physical property and franchise of the railroad company. The evidence of this indebtedness is the railroad bond.

It will be understood from the foregoing, that the holder of a bond is a **creditor** of the railroad, as distinguished from a holder of the stock, who is the **owner** of the railroad, and responsible for its operation and management.

The first railroad shares had paid a return of 8% on an investment in which little risk was involved. These new enterprises, however, were speculative, to a greater or less extent, and required a larger return on the investment on that account.

To stimulate the construction of new lines, investors were offered a share of anticipated profits. They were given bonds bearing 6 to 8% interest for their actual investments, which were secured by the physical property which their investment produced, and in addition a bonus of stock.

As heretofore shown in the chapter on Promotion, these investments were, in many cases, still further secured by other improvements and land, for which no **bonds** were issued—local investors accepting **stock** for their investments.

State Aid

The people of the interior districts—those lying beyond the then constructed roads and having no means of cheap intercommunication—appreciating the benefits which cheap transportation had conferred on those communities enjoying it, adopted means to provide themselves with railroads.

Through their state legislatures, they encouraged and assisted new railroad enterprises by subscribing directly to their bonds, or guaranteeing the interest

on them. This method of financing otherwise impossible enterprises, perhaps more than any other one thing, was responsible for the fact that bonds became the most important part of railroad capital.

It must be remembered in this connection, however, that a large number of the railroads have in the past, and at the present time do sell their stock at and above par in obtaining required additional capital. The general impression that only the bond (funded debt) portion of railroad capital represents actual cash expenditure is entirely erroneous.

Ratio of Stocks and Bonds

Originally some of the states prohibited the issue of bonds in greater amount than the total amount of stock, on the principal that a share of stock represented an amount equal to its face value, which was actually invested in the property and that the property acquired through such investment was the sole security for the payment of all borrowed money; hence bond issues would not be secured if they exceeded in amount the stock issue.

In 1913 the state of Massachusetts, at the time of placing the railroad companies' finances under the supervision of the public service commission, changed its laws and permitted bond issues of twice the amount of stock. Some other states allow bond issues to the extent of three times the amount of stock.

The following table shows the division of the total capitalization of all railroads in the United States, June 30, 1914, earning more than $100,000 annually.

Funded Debt

Mortgage Bonds..................	$ 8,496,370,538
Collateral Trust Bonds...........	1,182,683,530
Plain Bonds, Debentures, and Notes	1,142,016,070

Income Bonds	254,230,505
Miscellaneous Obligations	72,700,640
Equipment Bonds..................	418,540,270
Total Funded Debt........	$11,566,541,553

Stock

Common Stock....................	$ 7,304,479,846
Preferred Stock..................	1,376,279,858
Total Stock................	$ 8,680,759,704
Total Capitalization..............	20,247,301,257
Funded Debt Percentage of Total. .	57.13%
Stock Percentage of Total.......	42.87%

Certain portions of this total capitalization are held by the railroad companies, as the following statement shows:

	Stock	Funded Debt
Total Outstanding.	$8,680,759,704	$11,566,541,553
Held by Railways.	2,638,783,512	1,849,423,832
Not held by Railways........	$6,041,976,192	$ 9,717,117,721
Average per mile (not held by railways)	$25,492	$41,169

Total Actual Capitalization per Mile of Line. $66,661

The item of "Held by Railways" is deducted because there are duplications of securities—that is, operating systems issue securities based on the securities of their subsidiaries.

Combination

The result of the local and state encouragement of railroad construction was a large number of local roads, operating independently in their own territories, having little relation with each other. In the late 50's there were only a few roads, like the New

York Central and the Pennsylvania, with more than 100 miles of line, and these two had only about 500.

It became apparent to the shrewder railroad managers that the combination of these small, unrelated lines would be profitable, as increased traffic density would decrease operating expense and improve the traffic situation.

These combinations of smaller roads into small systems first, and later into large systems by further combination of the smaller ones, were effected in various ways. When the consent of all the stockholders of the two properties which were to be combined could be obtained, they were merged into one corporation. In other instances, one road leased another, operating it as part of its own road and paying either a fixed rental or one based on the earnings of the leased property. In still other instances, one road bought a majority of the stock of another road for the purpose of controlling its operation.

In order to avoid paralleling an operating road, traffic agreements have often been made, by which one road uses in part certain tracks, terminals, or other facilities of another road in common with it, at some agreed rental and under conditions provided for by agreement. Some roads are operated jointly by two or more roads, both of the latter securing an outlet, or connection, which would otherwise necessitate a duplication of transportation facilities.

In effecting these combinations, it was inevitable that in some instances certain properties necessary to a proposed combination of several lines were purchased at prices which exceeded their cost—that is, they were sold on the basis of their value to the purchaser, rather than on the cost to the seller.

It is the same proposition the farmer encounters when he buys forty acres of land to "square up" his

farm or the manufacturer when, through expanding business, additional land is required for extending his plant. All of them pay on the basis of their necessity.

On the other hand, many roads—a great many more than of the class just mentioned—were purchased, in forming these combinations, at prices far below what they had cost their original owners to construct. The circumstances which made this possible have been explained in the chapter on Construction and Reconstruction.

It will be noted, however, that **in all instances,** the railroads were sold on the basis of their value as transportation facilities—not on the basis of original cost, nor of their physical value.

Holdings of the Securities of Other Railroads

Combinations of roads by purchase of their stocks have been very much facilitated by the use of Collateral Trust Bonds* in financing such operations. A road with a good dividend record can sell its collateral trust bonds, based on the securities of the purchased road, and so obtain control of it with the expenditure of comparatively little money.

Inasmuch as the combination reduces operating expense and betters the traffic conditions, such securities are usually desirable, particularly if some guarantee of the bond or advantageous conversion clause is added.

It has often been necessary, in effecting the combination of two or more roads, to construct new lines to connect them. The price of the securities of an operating road would usually be affected injuriously if it undertook the construction of any considerable

*These are a mortgage issued by one railroad company on the stocks and bonds of another company, deposited with a trustee. They depend for interest upon revenues that accrue from these deposited securities.

mileage of connecting line, (or extension) in its corporate capacity. For this reason such work is performed under a separately incorporated subsidiary organization, whose securities, after the construction has been completed, are purchased with the collateral trust bonds of the parent corporation.

Railroads have often purchased a small portion of the stock of their important connections, to obtain representation on their boards, in order to protect their traffic relations with such connections. These holdings are usually only a small part of the total issue of securities of these connections.

It will be noted that by purchasing the securities of the lines which it seeks to combine with its own system, and those of the companies through which it constructs necessary connecting lines and extensions, the parent company accumulates a greater or less amount of the securities of "other railroad" companies.

It is difficult to understand why this practice of owning the securities of "other railroads" is so severely censured by the critics of railroad financial management, as the combination of the lines is beneficial to both the public and the investors in railroad securities. On a simple relation of the facts, the whole arrangement seems well adapted for accomplishing what is desired. Certainly the object to be attained is unobjectionable from any standpoint.

There is no doubt that this method of financing and control may be used improperly, but the same is true of any other. There is nothing wrong in one railroad company owning the securities of another, unless there is some particular circumstance that makes it so. The wholesale condemnation and suspicion of such ownership, without regard to the circumstances attending it, is unjust and not warranted generally by the facts.

Holding Companies

The practice of bringing large mileages of various systems of railroad under one general management, exercising control through small holdings (nominally) of stock, has also been very severely criticised and characterized as "high finance," and as being dangerous and prejudicial to the interests of the general public and to investors in the securities of the railroads concerned.

The financial authority of the many constituent railroads of a large system must be concentrated somewhere, and it must be absolute to be effective. If it were necessary to consult the holders of the securities of each subsidiary company, the management of all large systems would be embarrassed to such an extent that it could not hope to be effective. Holding companies, when properly employed, are used to concentrate financial authority of many related companies.

The Atlantic Coast Line Company is such a holding company. It has financial control of the Atlantic Coast Line Railroad Company and the Louisville & Nashville Railroad Company, the former having 21 subsidiary companies and the latter 22. The aggregate length of the two systems is about 11,000 miles, and the total capital approximately $725,000,000. The capital of the holding company is $12,600,000. Control of the holding company could be had by owning $6,400,000 of its capital—that is, $6,400,000 could be made to control 11,000 miles of railroad and $725,000,000 of railroad capital.

These two systems are not competitive, but supplement each other. In the operation of the properties, the organizations are entirely independent of each other; it is only in the financial management that they are under one control.

What essential difference is there between such an arrangement for financial direction and say that of the Atchison, Topeka & Santa Fe, which is a system of 11,000 miles under one control?

The Louisville & Nashville is typical of all large American railroad systems. It has been formed largely by the combination of many small roads, the majority of which were not profitable when operated independently.

These smaller roads paid high rates of interest on the money actually invested in them. In some cases they were not operated as efficiently as desirable and as to practically all of them, insufficient revenue from operation prevented them from giving the best of service to the public. Many of them for a large part of their corporate life, were administered under the direction of the courts, by a receiver.

Both the Louisville & Nashville and the Atlantic Coast Line are honestly administered as to their finances, efficiently operated and give excellent service to the public. What ill effect to the public, or to the investors interested in their securities, has followed from the fact that they are administered financially through a holding company?

The mere fact that a group of dishonest men **might** control such large interests is no argument against the method. Abuses arising from mis-management may be corrected in the courts, as the course of events in the Rock Island System's affairs show. Men, or groups of men, in charge of small railroads have been dishonest quite as often as similar men in charge of large railroads systems, and the same is true of industrial corporations.

An objection based on the possibilities of dishonesty would rest against any of our institutions, such as the United States Supreme Court or the Interstate Commerce Commission as well as against the holding company.

The possible damage and loss which either of these highly respected agencies might inflict on the people whom they serve is incalculable. The fact that they **might** do so does not deter us from vesting them with our authority. If they should prove unfaithful we would dismiss them individually, but would not, for that reason, abolish the Court or the Commission as institutions.

In large affairs, particularly in financial management, there must be a concentration of authority and freedom from embarrassing restraint. A holding company, or some equivalent method of control, is essential, in some instances, to efficiency in financial management and is not prejudicial to public interest. In the instance used above for illustration, it would be utterly impracticable to vest the financial authority of the system in the 43 constituent railroads, located in ten Southern states.

The following important and practical advantages are responsible for holding companies:

They concentrate the financial control of many subsidiary corporations and hence assure greater efficiency in financial management; they provide a means of financing new construction in several states; they facilitate the combination and extensions of systems, by the issuing of their collateral trust bonds, based on the securities of their subsidiary companies; they widen the market for railroad securities, as their **bonds** are available for certain investments, while the **stocks** of the controlled railroads are not.

Reconstruction

The combination of various independent lines into systems concentrated traffic along certain of them, necessitating their reconstruction, to effect savings in operating expense, as stated in the previous chapter on Construction and Reconstruction.

The cost of this reconstruction, which has been very large, is responsible for practically all of the increase in capitalization of most railroad systems. Some other factors, hereafter mentioned, have contributed somewhat to this increase, but such amounts, while large in the aggregate, are small relatively, when compared with actual reconstruction cost, a considerable percentage of which has never been capitalized at all.

Readjustment of Bonded Debt

A railroad is never finished. It is constantly being improved—reconstructed, extended. The modern railroad system, in normal times, is consolidating independent lines with its system and segregating others which its experience indicates are not needed in its development or operation. It must constantly adapt itself to the changing conditions of a developing country, and so long as the country progresses, these changes in its organization and additions to and improvements of its facilities must be expected and provided for by its financial organization.

There are only a few securities in this country which are issued with perpetual interest-bearing provisions; most investors prefer a bond providing for the payment of its principal at some specified time, as 30 or 50 years from its date of issue.

It is not often intended that the bond shall be actually paid in cash at maturity and the obligation be discharged. Modern financing contemplates the payment of the principal of railroad bonds by the issue of other bonds, which is termed refunding the debt which the original bonds represent.

The purpose in naming a definite time for the payment of the bond is to provide for an adjustment, at stated intervals, of the rate of interest which the bond pays. If the current rate of interest

on other long term investments varies considerably from the rate of the railroad bonds, their market price will vary proportionally with the difference in the two rates, and it is desirable that the price of bonds be comparatively stable.

The constant need for additional railroad capital to pay for additions and betterments, in connection with the varying conditions of the money market, results in securities of varying rates of interest and with many differing conditions and a large mass of securities of conflicting and often of uncertain relative rights. In the reorganization of the Union Pacific in 1895, there were fifteen different committees, representing separate interests, owning the various classes of its securities; in the Atchison Topeka & Santa Fe reorganization of 1889, there were forty-one groups of bondholders.

For these reasons, periodic readjustment of the funded indebtedness of all railroad companies is an essential of sound financial condition.

Reorganization

Most of the railroads of the country have, in whole or in part, been through one or more reorganizations of their finances, following a receivership caused by bankruptcy. These financial difficulties have been caused either by extensions into undeveloped territory, dissension among bondholders, or too small a margin between net earnings and fixed charges.

All of the long extensions, particularly of the Pacific roads—those involving the construction of several hundred miles of line at one time—have been attended by bankruptcy.* It is an inevitable accompaniment of such enterprises.

*The extension of the C., M. & St. P. to the Pacific coast was made **after** the country had been developed. It is, of course, an exception to this general statement.

In the western and southwestern portions of the country, there are hundreds of miles of barren territory—absolutely devoid of traffic before it is provided with transportation—which must be traversed in reaching the rich traffic territory of the Pacific Coast.

Evidently a railroad may not be terminated in a desert, where there is no traffic, when rich traffic territory lies beyond it. The lack of revenue in a territory barren of traffic for some years following the construction period, together with the high price which must be paid for the use of money employed in such hazardous enterprises, have, however, combined to bankrupt all of them.

The situation in the far western country is not analogous to that of states east of the Missouri River, where the line developed its traffic **as it was extended,** and it was in consequence wise to make shorter periodic extensions, allowing time in the intervals for at least a partial development of the country already traversed.

In addition to the main line, the development of a territory to a paying basis also involves the construction of a considerable mileage of branch lines, whose aggregate cost may be a large percentage of the total cost of the main line. The Western Pacific, as it now exists, is an example of a line constructed across barren areas **to** a territory rich in traffic, which it does not now reach for lack of developing branch lines.

The factor of time—time required for the development of the business and of the country—has operated against all of them, without regard to details of management or plan of financing. This by some writers has been termed "over-expansion," and yet it is an unavoidable accompaniment of railroad building of this kind.

In many instances, particularly in the earlier railroad construction period, the large construction cost, the high rate of interest on capital, or small earnings, either singly or in combination, have made the operation of some roads unprofitable. In such cases the only feasible financial plan is to scale down the funded debt to such an extent that the net earnings, less fixed charges, leaves a balance as a profit for operating the road. Such conditions require a reorganization of the whole financial structure.

It generally has happened that the larger part of the bondholders have received no interest for some time prior to the reorganization. The stockholders are usually required to pay all or the larger part of the cash required to rehabilitate the physical property and provide the necessary working capital for the reorganized company.

As the reorganization has been occasioned by inability to pay fixed charges, it is essential that the funded debt be reduced, so that fixed charges may be proportionately reduced.

Certain classes of the junior bonds, in all reorganizations, will be replaced partly by mortgage bonds and partly by stock or income bonds, the payment of interest on the latter being conditioned by the clause "if earned"—that is, **a large part of the security** afforded by the foreclosure power of the old bonds **is surrendered for a contingent interest in anticipated, but unassured** profits of future operation.

This sacrifice of a portion of the **security** of the investment, and the **loss of interest** during the period prior to reorganization, is generally compensated for by a larger aggregate amount of bonds and stock than the former amount of mortgage bonds.

To illustrate, in the Atchison, Topeka & Santa Fe reorganization of 1895, certain bondholders were given \$75 in new mortgage bonds and \$40 in income bonds—a total of \$115 in securities—for each \$100 of their old mortgage bonds, the interest payment on the income bond being conditioned "if earned." As these bondholders had received no interest for three years prior to the reorganization, they were (in effect) to be paid defaulted interest later **if future operations proved profitable.**

This plan reduced the funded debt 25% and so was good financing, but it increased the total capitalization 15%, which, under the circumstances, was was a fair adjustment.

Likewise, the stockholders, who advance cash for rehabilitating the property and furnishing working capital, are given part bonds and part stock for their cash and old stock.

The net effect of all reorganizations has been to reduce funded debt and to increase the total capitalization, which, considering the losses of the secutitity holders prior to the reorganization, the surrender of their foreclosure rights, and the cash payments of the stockholders for reorganization purposes, is not an unfair adjustment of a difficult situation.

The increased capitalization following reorganization, has been more widely criticised than any other one feature of railroad financing. A fair statement of the conditions obtaining at the time of reorganization would be, that the adjustment, as between the various security holders, has usually been fair, and that the increased capitalization represents previously defaulted interest on the bonds and new cash put into the property for the purpose of rehabilitating it, paying the floating debt and providing a working capital.

This is not "high finance." It is an adjustment in railroad finances similar to those made every working day in the year in both large and small undertakings in commercial and industrial lines.

Commissions and Discounts

The marketing of railroad securities, in large amounts, requires the services of underwriting syndicates. Such services must be paid for from the proceeds of the sale of the securities.

In some instances these commissions amount to very considerable sums. In 1903 the Pennsylvania paid a commission of 2½% on an issue of $90,000,000 new shares; in 1905 the same percentage on a $100,000,000 issue of convertible bonds; in 1908, following a panic, it sold its mortgage bonds at 92 to a syndicate of bankers.

The New Haven had a contract with Morgan & Co. for underwriting its bonds for a commission of 1½%; after the collapse of the Mellen management it paid commissions of 2½% per cent on its 6% convertible bonds.

In other instances, in addition to the underwriting charges, the bonds are sold at a discount. The Western Pacific, under financial stress, sold its bonds, which were guaranteed by the Missouri Pacific and Denver & Rio Grande, at the large discount of 20%, realizing 40 millions in cash for 50 millions in bonds.

The amount of these commissions and discounts will vary with the conditions prevailing in the money market at the time the securities are issued. While these charges will be less for the stronger companies than for the weaker, they are **common to all railroad issues of securities.**

It is evident that if no provision is made for them, that repeated readjustments will seriously affect

the capital of the company. Some device for meeting such charges should be provided, as the expenditure is not represented by any tangible asset of the railroad. They must be considered also in making a valuation of the property.

Summary

The following are the essential facts relating to capitalization:

The total capitalization—by which is meant the sum of the funded debt (represented by bonds) and the capital stock or shares—for the railroads of the country, **as a whole,** probably does not exceed the present cost of the property, that is, its original cost plus what has since been expended upon it in betterments and improvements.

The capitalization of some systems is less than actual cost on account of the construction of new and reconstruction of old lines out of earnings—no additions to capital having been made to cover the cost of such work.

Some systems, through purchase of bankrupt and other railroads, at prices much below their cost, have a total capitalization less than the actual cost of the railroads which such capitalization covers.

Only in isolated cases does the funded debt alone equal the present cost of the physical property of the railroad.

In some cases, through large issues of common stock, the total capitalization exceeds actual present cost. The percentage of mileage of such roads to the total mileage of the country is small.

As a corollary of the preceding propositions, the capitalization of any particular road does not necessarily bear any relation to its actual present cost.

The practice of one railroad owning the securities of another is generally caused by necessities of

financing in combining various railroads or in extending existing systems. As the combinations are in the interest of the public and the railroad investors, there is nothing improper in the practice, unless there is some circumstance—applicable to that particular situation—that makes it so. General condemnation of such ownership, therefore, is not warranted.

The organization of a holding company does not involve any principle inherently wrong. The chief objection that has been urged against them is the possibility of using them improperly. The same objections may be made as to our most cherished administrative and judicial institutions. Some of our most efficient railroad systems, which are controlled financially through a holding company, are honestly administered, efficiently operated and give excellent service to the public and are the best argument in justification of this method of financial management.

The increased capitalization following reorganization usually represents an adjustment of previously defaulted interest on bonds and cash payments for rehabilitating the property, for discharging the floating debt and for providing working capital. The methods which have been used in reorganizations are not those of "high finance," but are similar in nature to every-day adjustments in large and small undertakings in commercial and industrial lines.

The increased capitalization per mile shown by the statistics of the last twenty years, is due almost wholly to the expenditures for reconstruction and other beneficial improvements necessitated by increased traffic density.

Unless provision is made in rates for the payment of commissions and discounts incident to

financing extensions, reconstruction, readjustment, and reorganization, such charges will seriously affect the capital account. These charges must be considered also in making the valuation of the property of railroads.

The following table, showing the capitalization per mile of fifty prominent railroads for the year 1914, divided as to funded debt, preferred and common stock, will be interesting in connection with this statement:

Capitalization of Fifty Important Railroads

(Compiled from publication of Kissell, Kinnicutt & Co., Brokers, Chicago and New York.)

*Year Ended June 30, 1914.

Railroad—	Average Miles Operated.	Per Mile of Line Operated. Funded Debt.	Preferred Stock.	Common Stock.	Total Capitalization.
Atchison, Topeka & Santa Fe	10,908	$28,712	$10,467	$17,952	$57,131
Atlantic Coast Line	4,646	28,536	44	14,541	43,121
Baltimore & Ohio	4,478	88,394	13,146	33,947	135,486
Boston & Maine	2,252	39,451	1,399	17,542	58,482
Buffalo, Rochester & Pittsburg	581	51,184	10,327	18,072	79,583
Canadian Pacific	11,825	20,509	6,615	21,987	49,111
Central Railroad of New Jersey	678	68,246	......	40,467	108,713
Chesapeake & Ohio	2,346	74,692	......	27,767	101,459
Chicago & Alton	1,033	83,135	x841 z18,919	18,918	121,813
Chicago, Burlington & Quincy	9,139	22,236	......	12,128	34,363
Chicago Great Western	1,496	25,563	29,504	30,245	85,312
Chicago, Milwaukee & St. Paul	9,684	34,418	11,963	12,066	58,447
Chicago & Northwestern	8,070	26,245	2,775	16,123	45,143
*Cleveland, Cincinnati, Chicago & St. Louis	2,381	40,233	4,199	19,763	64,195
Colorado & Southern	1,866	33,283	†4,555 ‡4,555	16,613	59,006
*Delaware & Hudson	904	68,938	......	47,016	115,954
*Delaware, Lackawanna & Western	958	334	......	44,130	44,464
Denver & Rio Grande	2,583	47,868	19,270	14,712	81,850
Erie	2,257	110,846	†21,219 ‡7,084	49,791	188,940
Great Northern	7,781	38,650	29,700	......	68,350
Hocking Valley	351	76,054	......	31,339	107,393

*Fiscal year of railroads showing this prefix ends December 31, 1914. xPrior. zPreferred. †First preferred. ‡Second preferred. §Leased line. kCapital stock.

Railroad—	Average Miles Operated.	Per Mile of Line Operated. Funded Debt.	Preferred Stock.	Common Stock.	Total Capitalization.
Illinois Central	4,768	41,372	§2,095	22,922	66,389
Kansas City Southern	827	58,104	25,393	36,275	119,773
Lehigh Valley	1,440	53,563	74	42,015	95,652
Louisville & Nashville	4,937	37,363	......	14,364	51,727
Minneapolis & St. Louis	1,646	27,069	3,543	9,238	39,850
Missouri, Kansas & Texas	3,825	36,806	3,398	16,544	56,748
Missouri Pacific System	7,284	41,881	......	11,354	53,235
*New York Central	3,774	103,872	......	59,773	163,645
*New York, Chicago & St. Louis	523	54,822	9,560 21,032	26,768	112,182
New York, New Haven & Hartford	2,046	117,171	......	87,980	205,151
New York, Ontario & Western	568	53,947	7	102,313	156,267
Norfolk & Western	2,036	54,840	11,296	52,927	119,063
Northern Pacific	6,325	47,802	......	39,209	87,011
*Pennsylvania	4,511	52,529	......	110,663	163,192
*Pittsburg, Cincinnati, Chicago & St. Louis	1,472	48,697	20,323	25,540	94,560
Reading System	1,020	48,447	k41,648	......	90,095
Rock Island Co. (C., R. I. & P.)	8,205	35,141	......	9,141	44,282
*Rutland	468	24,964	19,352	426	44,742
St. Louis Southwestern	1,735	32,587	11,466	9,426	53,479
St. Louis & San Francisco	5,259	55,733	†949 ‡3,042	5,513	65,237
Seaboard Air Line	3,084	36,243	7,747	12,036	56,026
Southern Pacific	10,422	56,075	......	26,162	82,237
Southern Railway	7,032	35,521	8,532	17,064	61,117
Toledo, St. Louis & Western	450	64,155	22,198	22,198	108,551
Union Pacific	7,597	43,983	13,103	29,269	86,355
Wabash	2,514	43,434	15,592	21,161	80,187
Western Maryland	661	97,732	15,172	74,779	187,683
Wheeling & Lake Erie	459	95,105	10,864 26,129	43,573	175,671
Wisconsin Central	1,123	36,017	10,033	14,369	60,419

VALUATION

General

Valuations of property are made for various purposes. The valuation of steam railroad property is made usually for either of the following purposes:

Taxation.
Financing.
Sale, Consolidation or Segregation of one or more properties.
Lease—Trackage rights.
Establishing a system of accounting.
Rate Regulation.

The State of Michigan was the first to undertake the valuation of railroad property for the purpose of establishing the taxable value. Later the State of Wisconsin, under a clause in its taxing laws which provided for the taxing of railroad property on the same basis as other property in its vicinity, valued all of the railroads in that state. These valuations were also used in connection with rate regulation.

In procuring additional capital for railroad purposes, it is becoming more the general practice among banking interests to require a valuation of the physical property used as the basis for such financing.

In 1912 the Canadian Commission required the Canadian Pacific Railway to have its property in the Province of Ontario valued, before allowing a large issue of new securities. Very often bonds are issued secured by some terminal, bridge or large yard, and the specific property mortgaged is valued to determine the margin of safety of the loan.

When one railroad company is consolidated with another, the relative values of the physical properties, under some circumstances, will affect the agreement providing for the consolidation.

In some instances, mining and lumbering companies have owned both the mine or timbered area and the railroad serving it. After the country has developed to such an extent that it has become an important public carrier, the State and Interstate Commerce Commissions have demanded the segregation of the railroad operation from that of the mining or other industry associated with it.

The Mississippi River and Bonne Terre Railroad, in the lead district of eastern Missouri, is an instance of this kind, the railroad owned by the same corporation that owned the mines and smelters being segregated entirely from the mining interest in 1913, which necessitated the valuation separately of all of the railroad property.

Often one railroad leases its line, or some facility, for operation by another. In order to determine the fair rental for such use, the property is valued and the rental is made an amount giving a certain agreed percentage (interest on the investment) of the value of the property used.

The Grand Trunk and Wabash Railroads operate jointly the line belonging to the former, extending from Detroit, Michigan, to Buffalo, N. Y., and Niagara Falls, Ontario. All facilities are used jointly and the Wabash Railroad pays for the use of the property a certain agreed percentage on the physical value, such physical value having been determined by a detailed valuation.

The Interstate Commerce Commission requires that all railroad property accounts be kept in a prescribed form, which provides for more than fifty headings of accounts, as grading, bridging, rails, ties, locomotives, passenger cars.

As to such items as grading, bridging and many others, it is not possible for many roads to segregate these various items from their total cost of road, and in order to do so the physical property is valued in detail. The Manufacturers Railroad, a terminal road located in St. Louis, Mo., was valued, and the values determined were used as a basis for its accounting.

Capitalization—Valuation—Rates

The following discussion of the Federal valuation of the property of the carriers is presented in connection with the subject of railroad rates. In fact, the Valuation Act passed by Congress was enacted mainly for the purpose of facilitating intelligent rate regulation by the Interstate Commerce Commission. It has a further interest in the fact that a possible outcome of valuation and the discussion it will entail may be final government ownership, in some form, of the property of the carriers.**

The immediate result of the valuation will probably be felt less in these two directions, however, than in the matter of the **capitalization and credit** of the carriers. As shown in a following chapter, the relation of the value of the property employed in transportation to the rates charged therefor, is general only being applicable to the schedule of rates **as a whole**, rather than to any particular rate, or class of rates, or rates between particular points or territories.

In the opinion of the writer, based on a considerable practical valuation experience, a fair valuation of the property of the carriers will, in nearly all cases and certainly as to a majority of them, disclose a larger amount as the actual present value or worth

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**The writer does not believe that government ownership is either probable or desirable.

of railroad property than is represented by the present capitalization. Such a valuation, established under Government authority, should therefore serve to strengthen the credit of all such railroads, as, after it has been completed, investors may know the intrinsic values upon which their securities are based.

This discussion relates to the broader principles underlying valuation and certain elements of value which the writer thinks should be included therein.

A reading of the previous chapter on Capitalization shows clearly, that the capitalization of the modern railroad company does not necessarily represent, even remotely, its physical value; in fact, it seldom does so. The two extremes in railroad capitalization are represented by those companies who have raised all the money it was possible to borrow on their physical property and franchises on the one hand, and on the other by those companies who have improved and extended their properties with the minimum possible issue of securities.

The New York Central and the Pennsylvania Railroad Company proper, four-track railroads in large part, have a total capitalization of practically $163,000 per mile. The Erie, with its double-track main line just completed between New York and Chicago, has a capitalization of $189,000 per mile.

The Illinois Central, including its double-track main line from Chicago to New Orleans, has a total capitalization per mile of $66,000; the Wabash, practically single track throughout its whole extent, $80,000 per mile, and the Toledo, St. Louis & Western, $108,000 per mile.

Many railroads have expended a large part of their earnings in improving and extending their lines without capitalizing the cost of such improvements. The Pennsylvania and the Burlington are notable examples in a long list of companies pursuing such a

policy. It has been stated that the general policy of the Pennsylvania has been to spend a dollar for improvement for each dollar distributed in dividends. Whether this be true or not, a large portion of its earnings have gone into betterments of the property without capitalization.

*At the other extreme, the capitalization of the Chicago & Alton was increased arbitrarily, by a former management, $33,000,000, only $3,000,000 of which was expended in actual improvements of the property, the balance representing the amount on which the earnings of the road were supposed to give a fair return.

When the matter of the justice of a rate is under consideration, there arises a difficulty in determining the value of a railroad property from its earning capacity, as the earnings themselves depend directly on the rates which are in dispute. To establish a value of a property on such a basis, for the purpose of rate regulation, would simply be arguing in a circle.

As neither the capitalization nor the earning capacity may be used in determining the fair value of the property employed in rendering the service for which rates are charged, other values must be ascertained to form a basis for gaging the amount upon which a fair return may be demanded.

The defense of the railroads heretofore, in resisting the attempts at radical reductions in rates which have been ordered by various commissions and other rate-regulating bodies, has been that such rates were below the cost of the service, and if made effective

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*The statement made in this paragraph is based on public statements made at the time the matter was publicly investigated. The writer has no means of knowing whether these were accurate or not. Many such statements are grossly exaggerated. The statement is used here merely to illustrate the fact that the capitalization of various railroads is not based on uniform financial methods.

would operate to confiscate their property. This at once brings up the question of what their property is worth, that is, what is the value of the property on which they are entitled to a return?

Federal Valuation Act*

In order to meet this situation, Congress amended the "Act to Regulate Commerce" by adding a new section providing for the valuation of the property of all the carriers subject to the provisions of the Act. Stated very generally, the Act directs the Interstate Commerce Commission to ascertain various costs as to each piece of physical property, and separately, of all land used for common carrier purposes; of land held for other purposes than a common carrier; the financial and other history of present and preceding corporations; the amount and value of aid granted railroads by the United States, state and municipal governments; the amount and value of concession in rates made by the carriers to such governments.

A brief statement of the reasons which induced the passage of the Valuation Act will assist in obtaining an understanding of its principal provisions.

Summary of Commissions' Reasons for Valuation

The grounds upon which the Interstate Commerce Commission has based its demands for a physical valuation of railroad property may be summarized as follows:

(1) To obtain the cost and value of railroad property, franchises and equipment, as they were directed to do in the original Act to Regulate Com-

*Blackface type are used in this chapter to indicate the emphasis of the author of this book. This is to be remembered in reading quotations from other books, documents or laws.

merce, which involves among other things, the compiling of the corporate history of the (each) railroads. The cost and value, when found, will show "the relation existing between the present worth of railroad property and its cost to those who are the proprietors of it."

(2) To establish a basis upon which to pass a satisfactory judgment as to the reasonableness of railway rates.

(3) To establish a basis for reasonable railway taxation.

(4) To establish a proper depreciation reserve for the purpose of protecting investors against depletion of their property by an under-statement of the cost of maintenance, and to protect the public against unduly high rates by charging improvements to cost of transportation.

(5) To obtain the correct amount which is to appear as assets of the railroads in their balance sheets, which must be known to determine the profit secured to the investment.

(6) To determine which roads are under-capitalized and which are over-capitalized.

(7) To afford a means for the organization of railway statistics in general, "which is the foundation for all safe investigation."

Railway Securities Commission

The Railway Securities Commission, in its report to the President, advocated the valuation of railroad property and expressed its views of the relation which would or should exist between such valuation and the securities of the railroads.

This Commission stated that the valuation, if properly applied, should not involve a reduction of the outstanding securities of the railroads, nor the prevention of the issuing of new securities when the

amount of outstanding securities exceeded the physical value of the properties.

"An attempt to scale down old securities is clearly out of the question. Apart from the obvious constitutional difficulties of such a course, considerations of public expediency themselves forbid it. The direct loss from the unsettlement of legal and equitable relations would be very great. The indirect loss from the withdrawal of confidence in American railway investments would be immeasurable.

"It is hardly necessary to add that your commission does not believe that the cost of reproduction of the physical property of the railroads, however carefully computed, is the sole element to be considered in determining the present value of a railroad, or that the outstanding securities could or should be made to conform to any such arbitrary standard."

Senate Committee

The senate committee, reporting on the bill, said, among other things:

"The committee proposes certain amendments which it considers essential to enable the commission to secure every element of the value of the property of the common carriers, so classified and analyzed as to enable the commission and the courts to determine the fair value of the property for rate-making purposes.

"The courts, from the first, have used various terms descriptive of the values and elements of value to be determined as a basis for ascertaining the fair value of railway property. Some of these terms they have altogether rejected. Others have come to have an accepted meaning by commsisions and courts, and are recognized as covering all the elements of value attaching to the property of common carriers for rate-making purposes.

"When these values are once ascertained, each aids in correcting the other, and is given such weight as it is entitled to in enabling the commission and the courts to arrive at the fair value of the property of the carrier used for its purposes as a common carrier. These terms accepted by recognized authority are: (1) The original cost to date; (2) the cost of reproduction new; (3) cost of reproduction less depreciation; (4) other values and elements of value, that is, intangible values."

Senator La Follette, in presenting the report of the committee to the Senate, said, among other things:

"This bill does not prescribe the values that shall ultimately be assembled by the Interstate Commerce Commission in ascertaining the fair value as a basis for rate-making, but it does direct the Interstate Commerce Commission to ascertain every element of value which, under the decisions of the courts—the courts are still in a transition period—is now being considered as properly included in ascertaining the fair value of the railroad property as a whole in fixing reasonable rates."

What the Act Requires of the Commission

It will be well to state at this point, what the act requires the Interstate Commerce Commission to do in connection with the proposed valuation, and some other things which it does not require of it.

The act requires the ascertainment of three costs, viz:

First, what it has cost to produce the railroad as it now exists.

Second, what it would cost, at the time of the valuation, to reproduce the railroad new, if it were nonexistent.

Third, what it would cost, at the time of the valuation, to reproduce the railroad less the amount of

depreciation of its property existing at the time of the valuation. That is, depreciation must be definitely determined, and assigned a value in dollars and cents.

In addition, there are certain elements of value which an inventory of the physical property will not disclose, such as the expense of promotion, organization, engineering and the value of the business as a going concern, which must be ascertained.

The Commission is specifically directed to ascertain each of these costs and values separately, and to state the method used in determining them. While the **methods** used in determining them are discretionary with the Commission, the act does not leave to its discretion **which cost or value** is to be used for rate-making or other purposes for which the valuation may be employed. What value will finally be assigned to the property is to be determined **after** these various stipulated costs and values have been ascertained.

The reason for this has been shown in the foregoing statement of the discussion of the bill in Congress, viz: that the courts have laid down the rule in many cases, that **all** of the various costs and values provided for in the act have a bearing on the present value of the property and that the true value can not be determined except by giving consideration to **all** of them.

Provisions of the Law

The law provides for the valuation of all railroads engaged in interstate commerce and the securing of information concerning their stocks, bonds and other securities. It is an amendment, designated Section 19a of the Act to Regulate Commerce which was approved in 1887.

It provides that the Commission shall investigate, ascertain and report the value of all property owned

or used by every railroad engaged in interstate commerce, and it is directed to make an inventory which shall list the property of such railroads **in detail** and show the several values provided for in the act, classifying the physical property as nearly as practicable in conformity with the classification of expenditures for road and equipment heretofore established by the Commission.

The requirement of listing the property in detail necessitates the making of an inventory of each separate piece of railroad property, such as the quantities of material involved in excavating the cuts, building the embankments and the classification of such material, as earth, loose rock and solid rock; the quantities of rails, ties, track fastenings, switches, ballast; the quantities of steel, masonry and yardage and classification of materials in bridge foundations; the kind, size and quantity of all pipes, concrete and other culverts; the kind and quantities of material in fences, road crossings, telegraph and telephone lines of the railroad; the signal and interlocking plants; buildings, fixtures and grounds; docks and wharves; tools, machines and appliances for performing work, and every single piece of physical property of the railroad company.

Also in detail, as to kind, design and quantity, all locomotives, passenger, freight and work cars, floating equipment, power plants and their equipment, shops, enginehouses, turntables, water stations, fuel stations, and all other items of equipment and appurtenances relating to its construction, maintenance and renewal.

This inventory is not to be made in "lump sums," but **each** cut, fill, bridge, culvert, building, interlocker plant, signal, locomotive, car and transfer boat must be listed and valued separately.

In round numbers, there are 250,000 miles of railroad **line** in the United States, and, of course, many

more **track miles.** The amount of property to be valued under this provision of the law is somewhere between ten and fifteen **billion** dollars.* Ascertaining the value is the biggest job of its kind ever undertaken, and the valuation of all railroad properties will hardly be determined finally within the coming ten years.

Of the three costs which must be determined as to each separate piece of property, the first is original cost.

Original Cost

The idea of the law is to obtain the original cost of the railroad from the records of the company. This is a most difficult, in fact, impossible task, as to all of the railroads.

The old records of the Baltimore and Ohio Railroad were destroyed in the Baltimore fire; those of the Union Pacific Railroad in the Omaha fire; the Southern Pacific records in the fire following the San Francisco earthquake; of many of the large systems with headquarters in Chicago, by the fire of 1873, and the same is true as to the original records of many other roads.

In the combination of smaller roads into larger systems, many records were lost or destroyed, in fact many of the original records were of little value, as the systems of book-keeping were as numerous as the book-keepers, prior to the appointment of the Interstate Commerce Commission, in 1887. Often, in such combinations, the smaller road was bought outright, its original cost being of no interest to the purchasing road.

In many cases the actual construction of the railroad was performed by a construction company and the only record appearing in the railroad company's

*This does not include the value of real estate.

books is a statement of the amount paid such company as provided in the construction contract.

There was no uniform system of construction accounts prior to 1908,** and the construction and maintenance accounts of the companies were seldom kept, prior to that time, so that expenditures could be segregated accurately.

The railroads have been reconstructed, not only once, but several times as to many of them. Few of the original structures remain. Heavier equipment demands entirely new bridges, more substantial track structures, longer and heavier turntables, larger engine houses, and this has changed not only the **size** but the **character** of many structures.

It is quite likely as to most railroads, and as to some features in all of them, that the effort to obtain original cost must be abandoned.

Cost of Reproduction New

This cost is determined by supposing that the surroundings of the railroad remain as they are at the time of the valuation, but that the right of way of the railroad is bare and it is necessary to reproduce all of the structures, equipment and physical property of the company as it exists at the time of the valuation on such bare right of way.

The detail of the assumed condition is not definitely settled as yet. It is a matter of great importance, as the assumptions affect the unit prices at which different structures and material are to be estimated and as to whether some items are to be included or not.

The actual work of making the federal valuation is under the immediate supervision of a Director. In the early part of 1915 the Director submitted a list

**Classification of road and equipment accounts was not prescribed by the commission until 1908.

of questions to the railroads, State Commissions and others interested in the valuation, in order to obtain the views of all parties in interest as to the basis on which the valuation was to be made, that is as to the assumptions to be made in considering the cost of reproduction new, the manner of determining depreciation and appreciation, what overhead charges are to be allowed, the manner of determining unit prices, the manner of estimating cost of land and many other matters of vital importance in determining the various costs and values required to be ascertained by the Valuation Act. Some of these questions of the Director's will be discussed in order to make clear the more important factors which are involved in the making of a valuation of railroad property.

Assumptions as to Conditions

Director's Question (1): In determining the "cost of reproduction new," to what extent should reference be had to conditions as they existed at the time of original construction?

(a) The road runs through an orchard which did not exist at the time of original construction. In determining cost of reproduction new, shall the value of the land be determined with or without the trees?

(b) Should an allowance be made for clearing and grubbing and, if so, shall it be allowed where the road runs through what is now tillage land, but what at the time of construction was a forest?

(c) A building was wrecked when the road was constructed. Is the expense of the wrecking to be included in the reproductive cost?

(d) Are present geological and topographical conditions to be taken, or is inquiry to be made as to what these conditions were at the time of original construction?

(e) Should it be assumed that present transportation facilities are in effect, or must reference be had to such facilities as existed when the road was constructed?

In considering what are fair assumptions as to the conditions prevailing at the time of reproduction, no inflexible rule can be made to apply to all conditions and circumstances. Common sense in combination with fairness and flexibility must be the essence of the rules.

The fair assumptions are: That the right of way of the railroad is considered to be, at the time of the valution, in the same condition in which it was at the time of original construction; that is, it was not graded, and if it were in a timber country, it was covered with timber which had to be cleared and the roots grubbed out before the excavations could be made, and if any building or other improvement stood on the right of way, it had to be paid for, as well as the cost of wrecking and removing it.

The mere fact that some farmer had since planted an orchard along side of the right of way adds no value to the physical property of the railroad, and the railroad company should not derive any benefit from such a fact, nor should it be penalized because other farmers happened to cut all of the trees from the land on both sides of the right of way at other points.

In so far as the condition of the right of way is concerned, it should in **all** particulars, be considered as it existed at the time of the original construction, geologically and topographically, in so far as such conditions can be determined. In some cases it will not be possible to determine what all of the conditions were, accurately, but with general construction experience, some local inquiry and investigation of available records as a basis, and a desire for fair-

ness as a guide, there is little chance for serious erroneous assumptions as to original conditions.

That all transportation facilities are in effect as at the date of the valuation, except the one being valued, is the only practical assumption, all things considered. It is possible to build a railroad in almost any situation, at some price, but it is not humanly practicable and certainly not economically so, to construct a railroad in some situations if no transportation facilities were available for transporting certain materials necessary for its construction.

What would it cost to haul rails from Pittsburgh or Chicago to a railroad like the Union Pacific, starting at Omaha, if no transportation facilities were available? The prices at which rail and other track and bridge material would have to be estimated, on account of this haul, would be ridiculous.

Nor is this all, for if there were no rail transportation, most of the central states would be covered with timber, as there would be no market for it, and its price would be very low; there would be a very limited market for grain and other farm products, and in consequence fewer farms; interior manufacturing centers of any considerable size would not be possible, and the cost of all manufactured articles on the proposed railroad would be prohibitive.

Such assumption as that no transportation facilities are in effect do violence to common sense and lead the mind into vain and endless speculation. What effect such an assumption would have on an actual valuation would be difficult to say, for if followed to its logical conclusion it would effect many items of cost.

All rails and other articles of steel and iron manufacture would be estimated at very high prices; timber, at very low prices in some situations, very high in others; labor usually at very low prices; practically all of the grading would be estimated on the

basis of manual labor, as the cost of transporting heavy machinery, such as steam shovels, would prohibit its use.

To summarize and answer this question directly, the fair assumption for general application—and there may be some exceptions to it—the right of way of the railroad under valuation should be considered as being in the condition it was actually in when original construction was undertaken, and that the condition as to the adjoining land, transportation and other facilities and sources of supply, are those which exist at the time of the valuation.

Director's Question (2) Should the road be reproduced in the form and manner in which it was originally built?

(a) For example, gravel was brought from a considerable distance in point of fact, but a gravel bank is available to-day at much less cost. Shall the road be allowed the haul which was actually made?

(b) The rail originally was relay. In determining cost of reproduction new, should we apply the relay price or the price of new rail?

(c) The rail now in branch lines and siding was originally laid new in the main track and taken from there to the branch line or siding. Shall this be treated as new rail and priced and depreciated accordingly, or shall it be treated as relay rail when laid?

The reproduction should be generally of new structures of like kind as the existing structures. There are some exceptions to this.

As to the example (a), the road should be allowed the short haul on the ballast; to be consistent as to the assumption in regard to conditions stated in the last paragraph of the discussion of Question (1)—"sources of supply are those which exist at the time of valuation."

The other examples (b) and (c), with the attached questions, are impossible conditions. A relay rail is a second hand rail—an old rail, **which has been used,** as distinguished from a new rail. Evidently it is impossible to determine the "cost of reproduction **new**" with an article which is itself "second hand."

There are some things which must be treated in another way, and the following circumstance illustrates a certain class of items which require special treatment. A safe in the ticket office of a railroad under valuation had cost originally about $2,000, being an old safe, but in good condition and answering every purpose for which a safe was required. To reproduce in kind would have cost practically the same amount. An improved, modern safe, affording the same security and with equal usable inside space, could be purchased for $400, and that was the amount allowed as the cost of reproduction new.

The loss in railroad value was due to the advance in the art of safe-making and it should, as in any other business, be written off. This is not to be confused with obsolesence or inadequacy, which is another matter, as the safe under consideration served the purpose as well as a new safe. Such deviation from usual methods, however, must be carefully considered.

Three Periods—Organization—Construction—Development.

Simply making an inventory of the many single items and structures found on the right of way and assigning a unit price to each, without taking into consideration the relation they bear to each other and the cost of assembling them into a completed whole, will not give the whole cost of reproducing the railroad.

As shown in preceding chapters, there are three distinct periods that precede successful operation. In arriving at reproduction cost, it must be assumed that the same procedure must be had as experience shows has been followed in constructing similar work in the past.

In the chapter on Promotion, the initiation of the enterprise has been described in detail—the preliminary organization, obtaining the charter, the making of the reconnoissance, preliminary surveys and location, the maps, profiles and estimates of cost; estimate of traffic tributary to the line; the presentation of the matter to arrange for the financing of the work and the options and tentative agreements preceding actual construction.

All of these things require time and skill of the highest order. All of them are necessary to be done, and the cost of doing them must be included in the cost of reproduction new.

In the chapter on "Construction and Reconstruction," the next or construction period is described in detail. Standard and special plans, specifications, right of way maps and construction profiles must be drawn; the construction forces organized, and the work staked out and its execution supervised; the land not obtained by purchase condemned; agreements for crossing other railroads, for the use of roads, streets and other public places must be made, as well as for the crossing of the proposed track by private roads and public highways; the soliciting of bids and finally the awarding of the construction contracts.

The acquiring of the land and other rights, as pointed out, is a tedious process, often involving protracted litigation and much expense and delay. All of these things must be considered in the cost of reproduction.

After the construction period comes the one of development. The forces in the various departments must now be organized and trained to maintain the track and structures and operate the equipment; equipment must be "broken in" and properly assigned; errors in construction must be corrected; traffic must be obtained and experiments of various kinds, often expensive, must be tried; in fact, the work of the whole organization must be coordinated.

This period will extend over several years under the most favorable circumstances. At the beginning the earnings from operation will be nothing and gradually increase as the enterprise develops. These things are incident to the development of all railroads, and their cost is properly a part of the cost of reproduction and must be included in it.

Overhead Charges

The Interstate Commerce Commisson recognizes this and provides, through certain accounts in its classification of expenditures for road and equipment, the following:

Engineering.

Earnings and Operating Expenses during Construction.

General Expenditures, which includes: Law expense, stationery and printing, insurance, taxes, interest and commissions, other expenditures.

Director's Question (3): What overhead charges should be allowed, and in what amount? By overhead charges are meant items like engineering, contingencies, interest, taxes, etc. How shall the time necessary to reproduce the property be determined?

Engineering

Overhead charges for engineering will generally be uniform, but there are certain situations that re-

quire special consideration. The engineering cost is generally stated as a percentage of the cost of all road items,** real estate and equipment not being included.

On terminal and belt railroads and as to the large terminal facilities of the larger systems, the cost of engineering, expressed in a percentage of the cost of the work, is sometimes double that of the average cost of those portions of the railroad not similarly situated.

The actual cost of the engineering on new roads in certain general classes should form a fair basis for establishing the proper percentage to be used for estimating reproduction cost for any given road; that is, different roads and different divisions of the same road, should be classified as mountainous, hilly, rolling prairie, flat prairie, swampy, etc., and the actual cost percentage of engineering should be ascertained for such general types and applied generally to similar situations on all railroads.

If the variation between these types of road was found to be large it would be necessary to classify all roads in this regard; if small, a general average could be fairly used. The percentage used should, however, be based on actual cost records of a period as near the date of the valuation as practicable. The terminal properties should be investigated separately.

Contingencies

All valuations should contain an allowance for contingencies, to cover omissions, errors and uncertainties. Experience shows that final cost invariably exceeds estimates, even when the greatest care and skill are employed in preparing them, unless

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**Road items include all items of grading—as cuts fills and tunnels,—bridges, buildings, structures of all kinds and all physical improvements.

provision is made for the many contingencies arising during the prosecution of the work, as explained in detail in the chapter on Promotion.

Study of a completed railroad, with complete construction records** eliminates many of the contingencies which can not be foreseen in the case of an unconstructed road, but there are still large elements of uncertainty to be considered, such as claims, delays, fluctuating markets, omissions, uncertainties as to land values and damages, lack of knowledge of foundations,†† especially on the older roads where complete records are not available—character of material in tunnels, and many other items.

Some percentage of total cost must be added to cover these elements of uncertainty. The proper percentage, from the nature of things, can never be more than a guess. It should probably not be less than 5% in any case, and not usually more than 10% of the cost of all items, when applied to work already constructed.

Interest During Construction

Payments for the use of money are much the same as payments for labor or material. The company must have some fund from which to make payments during the construction period and must pay for its use. The amount to be allowed is the interest on the total cost of the road (exclusive of equipment), for a period equaling one-half the estimated construction period.

**Such records are seldom available, except on roads recently completed, and even as to these, details are seldom complete enough for any great refinement in estimating.

††Some valuators of wide experience contend that the percentage to be added for contingencies should be larger in reproduction estimates than in the case of new construction, on account of the lack of complete records as to original conditions—particularly as to foundation and tunnel work. There is much evidence to support this contention.

The allowance for interest during construction should be based on the credit of the company operating the road; that is, on what interest it actually has paid for the money borrowed in a period, say of ten years, preceding the valuation, averaging the interest rate for the entire period. This is the only safe basis for predicting this feature of reproduction cost.

The recorded experience of various railroads forbids the adoption of a general rate to be applied to all railroads alike. A railroad doing business in a highly developed mining or manufacturing district can certainly borrow money at a lower rate of interest than a line less favorably situated as to traffic possibilities.

The time necessary to perform the work can not be determined with any degree of refinement or of assurance of the correctness of the conclusion. No railroad over 11,000 miles long, like the A., T. & St. Fe, for instance, was ever built as a system at one time; our whole experience relates to piece-meal construction—a few miles or a few hundred miles at the most, at one time. Actual reproduction of such systems, simultaneously along the whole line, would be practically impossible.

The only course open for practical consideration of reproduction, is to divide the system into units, the proper length of which is open to discussion. The unit of operation is the division, which varies from about 250 miles on a road of dense traffic to 500 miles in some instances where traffic is light and train service in consequence infrequent, the average for the whole country being probably about 350 miles.

Except in cases where there is some special condition which does violence to the assumption, the unit for consideration of reproduction might well be the operating division. With this as a basis, a fair

estimate as to the time required for construction may be made, by considering in detail the quantity and character of the work to be performed. Large terminals, tunnels, difficult bridge foundations, particularly heavy rock cuttings, would of course require longer time to construct than light rolling prairie work.

Actual Allowances—General Principle

Such items of general expenditures as law, stationery, insurance and taxes, may be obtained from the records for such items on any given road, and the amount applied as to half the estimated time of construction, in considering reproduction cost. A bankers' commission should be allowed for the sale of securities.

In the Milwaukee Three-Cent Fare Case, Professor M. E. Cooley, who had charge of the valuation of the Michigan railroads for that state, testified that the following were fair percentages to be added to the inventory value:

	Per Cent.
For Contingencies, certain items.....	5
For Contingencies, general.........	5
For Engineering..................	4
For Insurance during construction...	½
For Organization and legal expense..	2½
For Interest during Construction....	6
Total..........................	23

Authorities do not agree as to the proper percentages to be added for the items named above, but the values shown will serve to indicate that the overhead charges form a very considerable percentage of the total value under all circumstances.

The general principle to be applied in the determination of all of these overhead charges is that

a percentage rate based on previous experience is the safest method possible. Any other method involves a large factor of speculation.

Cost of Reproduction New Less Depreciation

The writer's definition of the term depreciation, as used in this statement, is: **A lessening in value for the purposes for which the property is used.**

Before discussing the requirements of the Valuation Act as to depreciation, attention is directed to the distinction between the depreciation of the simple component parts of a property or plant and depreciation of the plant as a whole.

A tie or a rail is a simple property and a component part of the track or the railroad as a whole. The rail may deteriorate from age and use and such deterioration is depreciation **in the rail itself.** But if the rail is properly maintained at all times during its useful life and replaced by another at the end of such life, **the current depreciation of the rail** is not to be considered as depreciation of the track or **the railroad as a whole.**

If the rail is **not** properly maintained at all times and is **not** replaced by another when it comes to the end of its useful life, **the railroad as a whole is depreciated** by the amount of the **deferred maintenance or replacement** which is due.

Failure to make this distinction between the simple component parts of a railroad and the railroad as a whole—which from its nature has an indefinite life, through continuously applied maintenance and replacement of worn simple parts—has led many valuators into the error of stating that the **present value** of the property is to be obtained by deducting from the cost of reproduction new of the railroad as a whole, the current depreciation of some of its simple component parts, even when

proper maintenance has been applied to such parts, when and as often as needed and replacements of worn parts made when required.

The only actual depreciation in the property, as a whole, is the **deferred maintenance and replacements**—that is the maintenance or replacements which **should have** been previously applied, but which in fact were **not** applied when needed.

This subject is treated in greater detail in following pages, attention being directed to it in advance of the following discussion to emphasize the distinction of the depreciation of the many simple properties, which when placed in proper relation to each other make a railroad, and the depreciation in the railroad considered as one whole working plant.

The law provides that the amount of the depreciation for each separate part of railroad property be determined definitely and that such depreciation be subtracted from the cost of reproduction new to obtain the cost of reproduction less depreciation.

Depreciation—Appreciation

There are certain parts of a railroad that begin to depreciate as soon as they are installed. The most important of these are rails, ties, timber structures, bridges, buildings, equipment and machinery. There are certain other items that appreciate in value with age, such as graduation (excavation and embankments) concrete masonry and ballast.

The Director has submitted the following questions in regard to depreciation and appreciation which are discussed in turn:

Director's Question (4): Shall allowance be made for appreciation and if so as to what parts of the property? Shall account be taken of solidification and adaptation, and if so, shall this be by addition of a percentage of all grading quantities?

What allowance, if any shall be made for shrink or swell in determining quantities as shown by actual measurement in present embankments, and shall this allowance be made by reference to local conditions or by some uniform per cent?

Appreciation—Embankment

From the impact of operated trains and from the action of the elements, embankments become solidified; that is, the material returns to the condition which it was in before being excavated and moved into the embankment; it no longer shrinks and washes away, and it becomes covered perhaps with a growth of vegetation which protects it from the action of the elements.

There are, in some instances, extraordinary values to be attached to solidification of embankments. Roadbeds constructed across a marsh, or other swampy areas of considerable extent, usually have cost much more to maintain in the fifteen or twenty years immediately following construction than their original cost.

The railroads crossing the Kankakee and other marshes in northern Illinois and Indiana are examples of the type of construction referred to. The roads have been maintained only by the use of expensive pile retaining walls, cribbing, cross-laying and other devices. The amount of material hauled in by trains in the years succeeding the original construction period has often greatly exceeded the quantities as shown by the original cross-sections. The work too has extended to the bridges and culvert-structures under such embankments.

In the construction of second tracks and other additional facilities, built many years after original construction, the same difficulties have been encountered and are apparent now on work but recently

constructed. In some instances high railroad embankments have caused the ground surface on either side to raise as much as fifteen feet.

An embankment which has become stable in such a situation is evidently worth more (in some cases several times as much) than a newly reproduced embankment. In certain districts there are large areas of marsh or swampy ground, and appreciation in the value of the embankments due to solidification should have special consideration in them.

It will be difficult to determine the amount spent during the period of solidification in all cases, but a study of available data should be made in order that a fair general basis for estimating be found.

Appreciation—Excavation

On a new railroad the slopes of the excavations slide, or the material washes down into the ditches, requiring the employment of additional labor and work trains in keeping them clear. After a period of time (eight to ten years usually) these slopes become "seasoned" by the elements and remain stable and the cost of cleaning the ditches in the excavations is only a small part of the cost during the seasoning period. The additional expense of maintenance in excavations during the period of adaptation seems to bear a relation to the length of the cuts rather than the yardage. In excavations less than five feet this expense is probably negligable.

Additional allowance should be made for the removal of soft or otherwise unsuitable material which existed in the cuts at the time of original construction, and for cross-laying with timber or other device used which was essential to maintaining the operation of the road during the period of adaptation. Such additional allowance can not be made general but must be applied specifically in any given situation.

Embankments and excavations which have undergone seasoning are more valuable than when first constructed, and an item expressing this appreciation in value must be added to the cost of the reproduction new. It has been usual in valuation work to allow from two to five cents per yard for the appreciation of embankments, and from $500 to $1,000 per mile of excavations over five feet in depth.

Appreciation—Ballast

After tracks are first ballasted, there is a considerable expense involved in maintaining them at line and surface, due to the facts that the ballast works into the roadbed and that the ties have not become firmly embedded in the ballast. Extra labor is constantly required to adjust the track and additional ballast to maintain it at its proper level.

The original ballast under the ties in an old roadbed will generally be found below the bottom of the second or subsequent application of ballast used in raising the track out of face. Ballast placed on a foundation of previously compacted ballasting material is more valuable than ballast placed on uncompacted earth.

The measure of the appreciation is the value of the ballast contained in an area say 10 feet wide and 12 inches thick (approximately the area of the first ballast), less the value of the embankment which it displaces. For example, if ballast is worth 50 cents per yard and the embankment 25 cents per yard, the appreciation is 25 cents per cubic yard of ballast and this price is to be applied to 10 cubic feet or 0.37 cubic yards per lineal foot of track.

The allowance for appreciation of ballast should not be made in rock excavations or other material where the original ballast could not have been forced down by the traffic into the under-lying material.

If allowances are made for solidification it would seem to take care fully of the swell and shrinkage of embankments, for solidification is itself an adjustment or a return to its natural condition of material moved from its original place. The allowance of shrink or swell for the purpose of estimating the cost of haul is an unnecessary refinement.

Depreciation—General

Director's Question (5): How shall depreciation be determined?

(a) By mortality tables? If used, shall these be general or made with reference to the property of each carrier?

(b) By actual observation?

(c) By combination of these two methods? If by combination, what weight shall be attached to age and what to observed condition?

(d) Should obsolesence and inadequacy be considered?

Depreciation should be determined by a combina- of mortality tables—tables showing the estimated useful life of certain structures and materials—by observation, and in many instances the application of available data to special conditions.

Depreciation—Ties

General mortality tables must be used with care, having due regard to actual conditions. For instance, the average life of a tie for the whole United States ought not to be the basis of depreciation of ties on any given road.

Certain roads, as in Missouri and Arkansas, are located in territories where large supplies of good white oak ties are still available for their use. The life of these ties will often be over 11 years as the average for a whole division. Certain other roads,

as in Michigan, use principally softer, less durable ties, whose actual track life will hardly exceed 8 years in main line track.

Ties in a sidetrack may remain there safely for a period of twelve years, while ties in a near-by main-line must be removed in eight years. The record of tie purchases will show accurately the actual life of ties on any particular division, and for each kind of service, and the life so established should be the basis for depreciation **on that particular division.**

Normally, the removal of ties will be the same for each year. To illustrate: if the records show the average life of ties to be ten years and there are 3,200 ties per mile, the renewals each year will be 320 ties. Then the oldest ties in the track will have a remaining life of one year, and the newest ties a life of ten years, and the other ties a life varying from two to nine years, the average for all being five and a half years. The average depreciation then would be, four and a half years, or forty-five per cent of the total life.

Depreciation—Rail

Rail has three distinct values: new, relayer and scrap. When new, it is laid in the main line and remains there until it becomes worn to such an extent that it causes "rough riding" for fast passenger trains, when it is removed to less important or branch lines. At that time it becomes relayer. When it is no longer suitable for such service, it is again removed and placed in yards or industrial spurs, where it remains until it is finally removed and sold as scrap.

The rail records for any particular section of track will show the life of the rail in each situation, and the depreciation can be readily ascertained on that basis.

Consideration must be given to the conditions on the particular track under investigation. The rail in the main line will have a **main line life** of fewer years on a division over which 30 trains are operated daily than on a division over which only 10 trains are operated. On two main lines, both of which have the same number of trains, one being composed in greater part of few curves and easy grades and the other with steep grades and many sharp curves, the main line life of the rail in the former will be much longer than in the latter.

Rail taken from the main line and laid in a branch line track will not have a total life as great as if laid in a little used siding. The depreciation must, in the case of main tracks, on any division, be based on the record of **actual rail renewals** over a period long enough to show the average **main line** life of the rail on **that division.**

The total life—main line life plus life as relayer—of rail on any division can also be determined from the rail record. The depreciation of relayer rail will generally be based on observation, the limits of value being set by a maximum present value as that of relayer, and a minimum of scrap value plus 25 per cent, the latter value being based on the generally recognized assumption that any material in actual use is worth 25 per cent more than its scrap value.

Supposing **a main line life** of rail, from the records is 10 years; its **total life** from the records 30 years,* the following values in various conditions would obtain, on the basis of a cost of $30 per ton for new rail, $22 for relayer and $12 for scrap:

The wearing value **for main line service** would be cost new $30, less value as a relayer, $22, equal $8

*These values for life of rail must not be taken as typical for rail in these two classes of service, as they are only used for the purpose of illustration. Life of rail varies widely in different situations.

or a depreciation of 80 cents per ton, per year. After it had been in the track five years its depreciation would be $4 and its present value $26.

To depreciate rail twenty years old—in a branch line: The **relayer wearing value** is $10—relayer value $22 less scrap value $12—or an annual depreciation, on basis of 20 years relayer life, of fifty cents per ton. The total depreciation for the twenty year old branch line rail would be:

10 years in main line—depreciation 80 cents per year	$8
10 years in branch line—depreciation 50 cents per year	5
Total depreciation	$13

Present value—$30 new, less depreciation, $13, $17.

For any rail in use, the minimum present value would be scrap ($12), plus 25 per cent ($3), equals $15 per ton.

Such rates of depreciation would be based on normal maintenance. If observation shows that it has not been normal, further depreciation*** should be allowed in some instances, for the reason that no subsequent maintenance, in any amount, could offset certain damages to rail, such as the spreading of the head of the rail at joints, due to the joints being allowed to stay "down" for extended periods through neglected track work.

Depreciation as here outlined may be made with some assurance of practical accuracy. Depreciation on a basis of a general average for a system, a state or the whole country, would be unfair, giving in some instances depreciation much too low, in others too high.

***This is the only depreciation which affects the value of the investment or the true present value.

Depreciation—Buildings, Structures and Equipment

In station and other buildings, the government practice and classification may well be followed, which consists in assigning a certain life** to frame, brick and other buildings and depreciating them on that basis. To depreciate such structures on observation alone would be unreliable, as paint and small repairs conceal depreciation not visible, but which experience shows actually exists.

On the other hand, the life assigned to any class of buildings is based on normal maintenance and if inspection shows that the maintenance has not in fact been normal, the depreciation should be increased. No rigid rule may be laid down for the allowance to be made for lack of maintenance; it is necessarily a matter of judgement and careful inspection, with a basis of construction and maintenance experience.

In the case of such structures as timber trestles, their actual life may be obtained for any division from its maintenance records, and a straight line depreciation made on the basis of such recorded life.

Other structures, such as well constructed bridge piers and abutments, should be depreciated by the amount required to place them in 100 per cent condition. Often the only depreciation consists of the cost of re-pointing the joints or other inconsequential repairs.

On such items as equipment and machinery no general rule for appraising depreciation may be stated; it must be based on the experience and judgment of practical men.

The total useful life of such buildings is to be determined from the maintenance records of the road being valued—not on assumed values.**

Obsolesence and Inadequacy

Obsolesence and inadequacy should be considered carefully. Where the structure or machine does not perform, or is not capable of performing, any useful service, its value should not be included in the cost of reproduction, except as it might have scrap value.

An old round-house, used partly to house a small steam plant and as a storage warehouse, should be estimated on the basis of such use. An old cast-iron turntable appurtenant thereto, but too short to turn any of the engines in service, has no value other than scrap. In some situations it would not be entirely obsolete, but in the plant of a modern railroad, with large engines, it is wholly inadequate and of no value as a turntable. The same is true of the older engines, which are too light for either road or switching service; their value is that of scrap or what they would bring if sold for use in some other service.

Obsolesence and inadequacy should not be taken into account however as long as the structure, equipment, tool or thing is employed in beneficial service.

Depreciation Not Deductible From Capital

The purpose for which the valuation is made should determine whether or not depreciation should be deducted from the cost of reproduction new. If acquisition of the property is contemplated,* there is no question but that the depreciation should be deducted, as the purchaser assumes the burden of restoring the depreciated items to their condition new. When the valuation is to be used for rate-making purposes, however, the condition is different.

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*As a matter of fact railroads are sold on the basis of their value as transportation facilities—**not on the basis of physical value.** As a transportation facility, an old railroad is more valuable than a new one.

All practice, and the law itself in all cases, directs that the cost of the repair and renewal of structures and equipment be charged to operating expense. The cost of repair and renewal is not to be considered as a shrinkage of capital, or investment, but as **one** of the elements of the cost of operation, for which the rate charged must provide, in the same way as it does for the **other** elements of cost of operation. Being an operating expense, and in consequence a current liability of the stockholder, it is not deductible from the capital account except in case of sale, when the purchaser thereby assumes the liability of the stockholder.

Treatment of Depreciation

The reason for making this distinction in the treatment of depreciation arises from the necessity of solving certain problems presented by practical valuation. To illustrate:

The agreement for the use of Grand Trunk property, used jointly by that road and the Wabash, provided that the **cost of the maintenance of the property be apportioned between the two roads.** On account of this provision in the agreement, the Wabash assumed the liability of restoring the depreciation of the simple component parts of the property to their condition new and therefore in determining the value of the property upon which it must pay rental to the Grand Trunk, the depreciation, **both current and deferred, was deducted** from cost of reproduction new.

The valuation of the Canadian Pacific, in Ontario —which was made under an order of the Canadian Railroad Commission—was made for the purpose of determining whether or not the physical value of the railroad property justified an issue of proposed securities. The **depreciation** of the property—de-

preciation of its simple parts—**was not deducted** from cost of reproduction new. Note that the Commission was having the value of the property determined from an **investment** standpoint.

Railroads which are in a bad way financially are often investigated by financial institutions interested in their securities. In determining present value—the commercial value is the one that bankers are interested in—**the only depreciation taken into account is the deferred maintenance**—maintenance and replacements which should have been applied but which in fact have not been applied. This is the only depreciation which is regarded by them as affecting the commercial value of the property.

Analogy Between Railroads and Commercial Lines

The conditions in this particular, as to railroads, are not essentially different from those that obtain in other lines of business. The following illustration shows that in commercial lines, as well as railroads, the purpose for which the valuation is used determines whether or not depreciation is to be deducted from cost of reproduction new.

Suppose a printer starts business with one new press, the useful life of which is ten years and the cost $1,000; that each year, for ten years, he buys a similar press; in addition, he is to maintain a depreciation fund to keep his investment unimpaired. At the end of ten years, he will have ten presses, which have cost him $10,000.

The following table shows his financial status during the ten year period:

STATEMENT OF INVESTMENT, DEPRECIATION AND PHYSICAL VALUE

End of Year	Number of Presses	Total Investment	Amount Placed in Depreciation Fund	Total Physical Value of Plant
1st	1	$1,000	$100	$900
2nd	...2	2,000	200	1,700
3rd	...3	3,000	300	2,400
4th	4	4,000	400	3,000
5th	5	5,000	500	3,500
6th	6	6,000	600	3,900
7th	7	7,000	700	4,200
8th	8	8,000	800	4,400
9th	9	9,000	900	4,500
10th	...10	10,000	1,000	4,500
Total in depreciation fund			$5,500	......

His investment is now made up of $4,500 invested in the plant and $5,500 invested in a fund which is maintained to keep his original investment unimpaired—the two amounts making a total of $10,000. From this time on, one of his presses will come to the end of its useful life each year and the $1,000 placed in the depreciation fund each year will buy a new press to take its place and his plant will be maintained on that basis indefinitely.

At the end of the ten years, one press will have come to the end of its useful life and have no value.** The average depreciation on the other nine presses will be 50 per cent and their total value will therefore be $4,500, if sold on the basis of their physical condition—that is as second hand presses.

The printer's charges for the work done by his presses, are made up of (1) his operating expenses

**Scrap value is neglected to simplify the illustration.

(such as wages, power, rent, light, fuel, current repairs, etc.) (2) interest on his investment and (3) profit for conducting the business. In making his charges for work performed, at the end of the ten year period, he does not estimate his investment in plant at $4,500, but at $10,000; if he based his charges on the first amount he would not get a fair return on his investment.

The rate which he charges his customers is based on the $10,000 valuation. If he sold his physical plant, on the basis of its physical value, he would receive $4,500 for it and take the $5,500 fund to make his investment good.

That is, in case of sale, the depreciation of the property is deducted from the cost of reproducing it new, but so long as he stays in business, his **schedule of charges is based on the cost of a new plant,** with no deduction made for depreciation.

It is immaterial whether a depreciation reserve is actually maintained or not, so far as **the valuation upon which the schedule of charges is to be based** is concerned. The rates must be based on the cost of reproducing the plant new, if there is to be a fair return on the value employed.

The foregoing applies to that portion of depreciation that can not be taken care of by constantly applied maintenance. In the operation of his presses, the printer, at intervals of three or four months, must renew the rollers which ink the forms and replace many of the gears and other minor parts of the machine.

The expenditures for such repairs he regards as much a part of operating expense as pressmen's wages, fuel, light or any other current expense. He certainly will make no deduction in his charges for printing because the rollers on his press will need renewing in the near future.

In what essential particular is the depreciation of the rollers on the printer's press different from the depreciation of the ties in a railroad track?

Importance of Depreciation Method

An idea of the importance of the basis to be used in the treatment of depreciation may be had by considering what effect some methods of valuation heretofore employed by state commissions would have on capitalization or estimated present value, if applied to all of the railroads in the country.

In 1912 a valuation of 1,187 miles of line** was reported by the Kansas State Commission. The depreciation on the whole property was reported to be 26.1%. That is the cost of reproduction new, less depreciation was taken as 73.9% of the cost to reproduce the property new and **this 73.9% of reproduction cost was stated as the present value of the property.**

If this rule were applied to all of the railroads in the country, assuming their value to be the same as the capital, which is now 16 billion dollars in round numbers, there would be a shrinkage in value of railroad property of over 4 billion dollars.

Fallacy of Deducting Depreciation

A railroad ten years old, which has been properly maintained, is physically a more efficient tool of transportation than it was the day it was finished.

A passenger train that may be moved with entire confidence as to its safety at a speed of fifty miles per hour on the ten-year old road is utterly impossible on a new road. Any given freight engine can haul more tons of freight in a train over the old road than it can over the new road, and do it in less time.

**Union Pacific Railroad in the state of Kansas.

The new road will require more labor to maintain it than the old road.

That is, it costs less to maintain the structures and equipment, and its traffic, both passenger and freight, can be moved by it at less cost per passenger or per ton of freight, and give better service to the public when it is ten years old than when it was new. There has been no lessening in value for the purpose for which the property is used—carrying passengers and freight—and hence there can be no depreciation. The value of the older road, using the term in its commonly accepted commercial sense, is certainly greater than that of the new road.

Any method of depreciation which shrinks the capitalization of the older road below that of the new, or gives to the newer road a greater present value than the older road, evidently involves a most serious error in the basis or the train of reasoning on which it rests.

Ruinous Effect on Railroad Credit

If all capital invested in, or the present value of railroads, is to be reduced by the adoption of such a depreciation method of determining present value, it will be impossible in the future to secure capital for railroad construction or betterment, as an investor is assured in advance, that without regard to the fact that the property may be well maintained, and that it is a more efficient tool of transportation, his capital is to be arbitrarily reduced 26% within the following few years on account of current deterioration in the simple component parts of the plant. It is unthinkable that the Interstate Commerce Commission, or the courts, will ever sanction any method of ascertaining present value which involves such a conclusion.

It is begging the question to say that establishing the present value will have no effect on the **legal**

capitalization. The general public—the investors in railroad securities—will regard the Government valuation of the railroads as an expression of their intrinsic value—the true commercial worth of the property, expressed in dollars and cents, and the **amount on which a railroad will be allowed to earn a fair return by the Commissions and Courts, in judging rate schedules.**

If the present value is stated to be less than the capitalization, the stocks and bonds, which evidence the capitalization, will immediately be marked down by investors to the level of present value, without regard to hair-splitting distinctions as to the legal questions involved or to strained definitions of the meaning of the terms depreciation, capital and value.

Reasonable Interpretation of Depreciation Clause

The reasonable interpretation of that portion of the Valuation Act which requires the determination of depreciation, will be found in item (4)* of the summary of the reasons urged by the Interstate Commerce Commission, in its reports to Congress, for the need of legislation in regard to railroad valuation, viz: "To establish a **depreciation reserve** for the purpose of protecting investors against depletion of their property by an under-statement of the cost of maintenance and to protect the public against unduly high rates by charging improvements to cost of transportation."

Necessity for Depreciation Fund Questionable

Whether or not a depreciation fund is the best method for providing for the maintenance of railroad property is a question open to discussion. Attention is directed to the distinction between the maintenance of such properties as those of a gas or water company or an urban street railroad—which

*Page 143.

from the nature of their plants may not be maintained by constantly applied maintenance—and that of a railroad.

It is not economical to repair pipe lines in detail —that is to remove a pipe here and there and replace them singly. In a paved street, only a few inconsequential repairs are made from time to time in the track of a street railway, as the paved roadway adjacent to its tracks must be maintained for street traffic. The maintenance of such plants, speaking generally, is applied **periodically,** in large amounts.

The maintenance of the railroad plant, as to the most of it, is applied **constantly**, in small amounts—a tie here, a new angle bar on one side of a joint there, new bolts and spikes in many places, as the economical maintenance of the track demands.

There may be certain parts of a railroad plant, such as buildings and equipment, whose replacement should be provided for by a depreciation fund—that is open to discussion—but that maintenance of the larger part of the railroad plant is better provided for by the current expenditure for operating expense is hardly open to discussion in the face of practical railroad experience.

Actual Depreciation Allowances

In connection with the subject of Depreciation, some allowances which have been made in actual valuations may be of interest.

In the following statement the depreciations in Column A were those deduced in evaluating a railroad with the following mileage classification:

	Miles
Main Single Track	243.64
Main Second Track	88.02
Sidings	127.77
Total Miles of Track	459.43

The valuation was made in 1913.

In Column B are shown the percentages of depreciation used by the engineers of the Kansas State Commission, in a valuation made in 1912, applying to a mileage classified as follows:

	Miles
Main Single Track	1,187.42
Second Main Track	66.87
Siding and Passing Track	251.75
Joint Track	.41
Total	1,506.45

****Depreciation Allowances on Actual Valuations**
Road Items

	Item	A	B
1	Engineering	None	None
2	Right-of-Way and Station Yard Grounds	None	None
3	Real Estate	None	None
4	Grading	***	0.08%
5	Bridges, Trestles, and Culverts	9.6%	*
6	Ties	49.8	43.32
7	Rails	22.5	18.43
8	Frogs and Switches	25.6	21.11
9	Track Fastenings and Other Materials	26.2	17.61
10	Ballast	None	15.49
11	Track Laying and Surfacing	None	39.06
12	Roadway Tools		30.00
13	Fencing Right-of-Way	35.0	28.44
14	Crossings and Signs	50.0	30.12
15	Interlocking and other Signal Apparatus	29.3	8.66

**The depreciation shown in the table is the current depreciation of the simple component parts of the property—not the depreciation due to deferred maintenance.

***An allowance was made for appreciation of Grading.

16 Telegraph and Telephone Lines	34.2	27.80
17 Station Buildings and Fixtures	28.0	31.91
18 Shops, Enginehouses, and Turntables	38.9	36.31
19 Shop Machinery and Tools	48.0	44.80
20 Water Stations	26.7	19.79
21 Fuel Stations	32.0	30.40
22 Dock and Wharf Property	43.8	.....
23 Miscellaneous Structures	45.3	24.97
All Road Items	12.07	27.45
After adding all overhead charges	11.31	.....

* On Truss, Girder, and I Beams............12.98
On Pile Bridges..........................28.69
On Culverts..............................21.68

The percentages for a short but busy independent coal road in Southern Illinois, valued in 1915, are interesting. The main line mileage was 8.93 with 10.4 miles of sidings. The value of the equipment was somewhat larger than the value of all items of roadway and structures. Appreciation was allowed on graduation and offset the depreciation on other items to a large extent. The percentages for current depreciation allowed were as follows:

On Total of Roadway Items...... 6.3%
On Equipment 26.4%
Total Valuation after adding all overhead items..............16.2%

The small percentage of depreciation on Roadway items is explained by the facts that Real Estate, on which there is no depreciation, constituted 30% of the total of Roadway items and that the **appreciation** on graduation was 25% of the total depreciation on all other Roadway items.

A valuation, made in 1915, for a belt line in one of the larger cities of the Central States, having a

mileage of 25.25 of all tracks showed the following depreciations**:

On all Roadway Items..............1.8%
On Equipment 9.5%
All items of Roadway, Equipment,
and overhead charges...........2.0%

The total value of the property was at the rate of **$178,635 per mile of track.** Real estate constituted 72% of the total value of all Road items, and as there is no depreciation on this item and appreciation was allowed on graduation, the net depreciation was very small.

Whenever real estate forms a larger part of total value, as it generally will in terminal and belt railroads, the depreciation will be much smaller relatively than when the roadway and structures are relatively more important.

Unit Prices

In connection with the subject of Unit Prices, the Director has asked the following questions:

Director's Question 6: "How shall unit prices be determined? If for an average period, what shall the period be and shall it be the same for all railroads, no matter as of what date they are valued?

What allowance shall be made for the transportation of men and materials over the lines of the carrier itself while under construction?"

The unit prices should generally be based on an average of prices prevailing during a period of, say from 1910—the beginning of this decade—to January, 1915, with a provision for readjustment at certain intervals, say, at the end of this decade, 1920, if conditions at that time demand it.

**Current depreciation.

In the item of labor, the cost has increased steadily for all classes during the last ten years, so that it is certain that the average price paid during the preceding five years is not as large as it now is, or is likely to be during the next succeeding five years. The statistics of the Interstate Commerce Commission indicate and emphasize this condition.

The price of ties and timber, which form a large part of railroad value, is greater now than the average for the preceding period and is likely to be increased very considerably in the coming five-year period, and the same is true of all cars into whose construction lumber largely enters. Present prices rather than the average for the preceding period should be used for these reasons.

Rail prices have been practically constant for some years; bridge and structural steel prices as well as the cost of concrete and other masonry are about the same now as the average for the preceding period and that average might be used with entire fairness.

In considering this matter, it must be recognized that the valuation must be **maintained as to prices** as well as to quantities, which the law recognizes and provides for. It will be physically impossible to keep valuations up to date at all times, in this particular, and the only practicable method of preserving their value is to provide for periodic adjustments, required by changes in the cost of labor and material, when the statistics for a decade are available—as 1920, 1930.

The statistics of the Census could be used at such times and would be the basis, in large part, for making the readjustment in the valuations. The change in value due to change in the prices for the various items making up the valuation, would for subsequent periods, be made by applying a percentage determined by consideration of the effect which the

changed prices would have on the value of any item of the valuation.

In regard to the allowance to be made for the cost of transportation of men and material over the lines of the railroad itself, while under construction, the suggestion made in answer to Director's Question (3) would, if adopted, simplify the consideration of this matter. The suggestion referred to is the one made in connection with the question of time required to reproduce the property, and provides that usually the operating division be taken as the unit, it being clearly impracticable to consider the construction of large systems as a whole.

If this suggestion is adopted, the railroad should be allowed the same rates for transporting men and material over its own lines to its nearest division terminal as it would be allowed if it transported them for another railroad company—that is to say, the legal tariff rates.

The cost of transportation of material from such division terminal to the site of the work in which it is to be used would be at a construction rate of say 5 mills per ton-mile—the one heretofore very generally employed.

Land Values

The Valuation Act provides for the valuation of railroad land as follows:

"Second: Such investigation and report shall state in detail, and separately from improvements, the **original cost** of all lands, rights of way, and terminals owned or used for the purposes of a common carrier, and ascertained as of the time of dedication to public use, and the **present value** of the same, and **separately** the **original and present cost of condemnation and damages** or of purchase in excess of such original cost or present value."

The provisions of this section require the making of an inventory of each separate tract or parcel of real estate owned or used by the railroad company, which includes all land used for right of way, terminal purposes, yards, shops, office buildings, etc. The original cost of the land and its present value are to be stated separately.

Original Cost

To find the original cost of any land is easy when the consideration named in the deed transferring the land represents the amount actually paid for the property. Railroad real estate deeds, however, like other deeds, often name only a nominal amount—one dollar or one hundred dollars—as the consideration, while the actual price paid may have been many thousand dollars.

As to old transfers of property, it will not be possible to determine in all cases the original cost; for transfers made since the Interstate Commerce Commission's uniform classification of Construction accounts has been in effect (since 1908) the company's books, in connection with the deeds or the legal records, will show the original cost of the land.

Present Value

The present value of the property is a matter which will provoke much discussion, as the value of the real estate is a very large percentage of the total value of railroad property, the percentage varying with the method employed in valuation and also with the density of the population of the territory traversed.

The present value of the land will generally be established on the basis of the market price, as indicated by transfers of adjoining lands or lands in the vicinity. Where no recent transfers have been made, the values will often be estimated on the basis

of the opinion of those expert in real estate values in the particular locality under consideration.

Cost in Excess of Present Value

There is still another value to be determined, and that is the original and present excess cost to the railroad of the land used for railroad purposes over the market value of the land surrounding it which is used for other purposes, such as agricultural, commercial, manufacturing or residence.

It is a matter of record that the railroads have paid more per acre or per square foot for land they have acquired than the market price of land adjoining it. The reasons for this excess of cost lie in the factors of damage to abutting property and improvements and the cost of obtaining the land through condemnation proceedings in court. There are some other factors which are explained in detail in the following pages.

In all cases in which the railroad and the land owners can not agree as to the price to be paid for the land required by the railroad, such price and the consequential damage to adjoining land and improvements must be determined by a jury or commissioners appointed by the court. The item of **damage to land not taken** is the serious one for the railroad.

In condemnation proceedings, the court instructs the jury to find three values: (1) The market value of the land to be taken by the railroad; (2) The damage to the remaining land and improvements of the land owner, arising from the construction and operation of the railroad; (3) The benefits, if any, to the remaining land.

The amount to be paid by the railroad to the owner of the land is the market value of the land, plus damage to adjoining land, plus damage to improve-

ments, less any direct benefit which the railroad may confer upon the land.

If the railroad right of way cuts the remaining land into irregular or triangular shaped pieces, the damage will be several times the value of the land actually taken; if it necessitates the removal of buildings or passes near them, the damage to the improvements will be large. The railroad must pay the cost of the legal proceedings in addition.

Whether the price paid is established by the court or by agreement between the railroad and the land owner, these damages must be paid. On this account, the average price paid by railroads in country districts is from two to three times the market value of the surrounding land; in city districts, from one and one-fourth to two and one-half times such value.

These are the costs referred to in the act as the "original and present cost of condemnation and damages or of purchases in excess of such original cost or present value."

Method of Establishing Present Value

In order to bring out a discussion which will show the different views as to the assumptions to be made in connection with ascertaining land values, the Director has submitted, among others, the following questions:

Director's Question (7): "How should the 'present value' of lands used for transportation purposes be determined?"

"Should the cost of securing the right of way at the present time be determined?"

"The act calls for the 'present cost of condemnation and damages in excess of present value of lands.' What is the meaning of this phrase and how shall the information called for be arrived at?"

The term, present value, as used in the act, is evidently intended to cover the present market value

of the land without regard to its use for railroad purposes, because a following clause in the same paragraph provides **separately** for the present cost of condemnation and damages, or of purchase in excess of such * * * present value." That is, the act recognizes the fact that the present cost of acquiring land for railroad purposes is, or may be, greater than the present normal market value of similar lands acquired or used for other purposes.

The purpose in requiring both values arises from the fact that some commissions and others in interest have contended that certain opinions of the Supreme Court in reference to valuations have indicated that the court does not approve of the reproduction method of ascertaining present value as applied to railroad real estate.

This matter is only mentioned here in explanation of the provision of the act requiring that these two costs or values be reported separately. The opinion of the court in question will be referred to in the following discussion.

With this view of the matter, the present value of the land is to be established by ascertaining the value of land adjoining or in the vicinity of the railroad line, which may be done on the basis of recorded transfers, or the opinion of those expert in land values in the territory under consideration, and often by a combination of both methods.

The method of ascertaining present value by establishing the ratio existing between the assessed value and the market value may be used as a check on the methods just mentioned, but should not be substituted for them.

Necessity as to Time and Location

In determining the value of railroad land, however, it must ever be borne in mind that such land

is always obtained under necessity, both as to **time and location,** which tends **in every instance** to increase the price over the price of normal land transactions in which such necessities do not appear as factors.

To illustrate, let us suppose that a manufacturer requires a city block of property upon which to build his proposed manufacturing plant. If **any** block in the city will serve his purpose, his land purchase may be made at the minimum cost, on account of the competition among owners of suitable property willing to sell. If some necessity demands that the city block be within a certain area, say one mile square, his market in which to purchase will be narrower, with the probability that the price to be paid will be somewhat higher.

If he is compelled to buy **some one particular** city block, he must purchase at the sellers' price, as there is no competition among the owners to sell, as there was in the first instance mentioned. If to this necessity, as to location, we add the necessity that the purchase be made, say, within thirty days or three months, his difficulties are multiplied many times.

The railroads as to practically all of their lands are compelled to buy under necessity, **both as to time and location.**

In ascertaining the cost of reproduction new, the cost of acquiring the land must be added to the present value, established as above. There are, in the case of all railroads, certain lands which must be condemned, such as the lands of minor heirs. In addition, experience shows that there are certain land owners with whom an equitable bargain for acquiring the land can not be made, and such land must in consequence be condemned.

The condemnation proceedings involve legal expense, the expense of expert witnesses and usually long delays. All of these circumstances are factors in determining the cost of reproduction new and an amount should be added to the present value to determine the reproduction cost.

Adjustment of Boundaries of Abutting Property

In this connection, attention is directed to the fact that the conditions attending the acquirement of land when cost of reproduction new is to be ascertained, are different from those which existed at the time the land was acquired for original construction.

At the time of original construction, the existing boundaries of agricultural lands usually conformed to some system of State or the Federal Government's subdivision of lands; the existing boundaries of land in cities and towns conformed to the lines of the subdivisions of property into lots and blocks, as made by the original owners.

The right of way of the railroads at the time of original construction, in most instances, could not be located to conform to the existing land boundaries and in consequence the taking of a narrow strip of land across an existing farm or city block damaged the remaining lands of the owner, as well as his buildings and other improvements.

The records show that the damages were sufficient to make the cost, per unit of area—as an acre or a square foot—of railroad land, in territory outside of cities, from two to three times, and in cities, from one and one-fourth to two and one-half times the market value of adjacent lands.

During the time between the original construction and the present, the owners of the land abutting on the railroad right of way have in nearly all instances

adjusted their boundaries with reference to the right of way boundaries.*

A reference to the two sketch maps,** showing the conditions at the time of original construction and the time of reproduction, will make this clear. It will be noted from the sketch showing the conditions at the time of original construction, that the lands of Jones and Brown were very seriously damaged by interposing the narrow strip of right of way across these lands, cutting both of them into two irregular shaped parcels where there had been but one before.

The operation of trains was a continued source of inconvenience and perhaps danger to the occupants of the property in passing from one to the other of the two parcels of land, which the right of way separates.

It has usually happened that after the railroad has been placed in operation, Brown sells to Jones all of his land on one side of the railroad and Jones sells to Brown all of his land on the other side, and as a consequence neither is subjected to the danger and inconvenience of crossing the right of way. The same is true as to other lands shown on the sketch—that is, they will have very generally adjusted their boundaries to the boundaries of the railroad right of way.

The conditions, then, at the time of the reproduction will not be those existing at the time of the original construction. There will usually be no severance or consequential damage to the land not taken, because the right of way would only take the outside edge of the parcel or tract of land and its cost, if condemned, would be the same as the market

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*This statement applies generally. In the case of a railroad under valuation which had just been completed, the adjustment of land boundaries to the right of way might not take place immediately.

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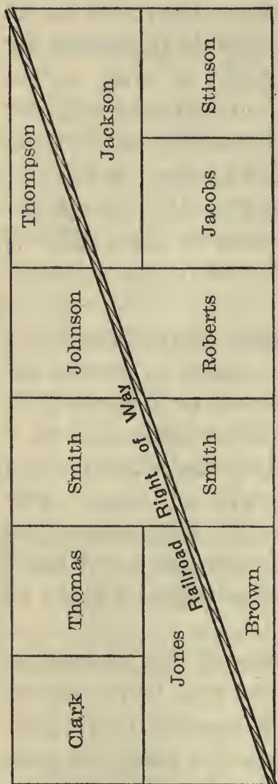
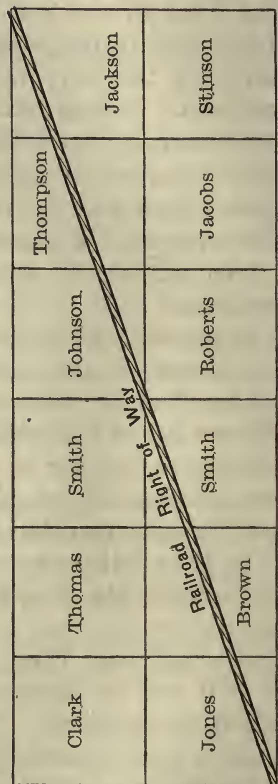


Real Estate Boundaries at Time of Reproduction



Real Estate Boundaries at Time of Original Construction

price** of abutting land, plus the cost of acquisition.

In such cases as that of the land of Smith, on the sketch showing conditions at reproduction, in which the land on **both** sides of the right of way is held by the same owner, severance and consequential damage must be considered at the time of reproduction in the same manner in which it is considered at the time of original construction, if the cost of reproduction new is construed in its literal sense.

Fallacies in Former Land Valuations

In certain valuations which have heretofore been made by or for some of the railroads, the present value of the land was determined by another method, which failed to take into account the difference in conditions prevailing at the time of reproduction and of original construction.

The present value of land (cost of reproduction) in the valuations referred to, was obtained by multiplying the market value of the lands at the time of the valuation by certain factors. These factors were derived from the records of actual cost, which showed the relation existing between the market value of land and its cost to the railroads when acuired for **construction** purposes.

As previously stated, land acquired for construction purposes outside of cities and towns has cost the railroads as an average, from two to three times and within cities from one and one-fourth to two and one-half times its normal market value.

The error in these valuations consisted in the failure to take into consideration the adjustment of the boundaries of abutting lands to the right of way,

**It must be remembered that this market price is to be based on the purchase being made under necessity as to time and location.

which had been made during the period following original construction.

In the Minnesota valuations—the ones which were used in connection with the case known as the Minnesota Rate Case—a second and additional error was made by assuming a value of land for railroad purposes higher than the market value of surrounding land **before** multiplying by the factors mentioned above. The court very properly decided that the valuation of real estate on such a basis could not give the true present value of the property.

It has been assumed in some quarters, from the refusal of the court in this case to accept values derived as just described, that the reproduction method of determining present value is not to be applied in valuing railroad real estate.

Had it been shown that the larger cost of railroad real estate is to be accounted for by reason of the necessities as to **time and location** and the cost of condemnation proceedings, and if the valuation had taken into account the adjustment of the boundaries of abutting property—in cases where such adjustments had been actually made—there can be little doubt that the court would have accepted the principle of reproduction as applied to railroad real estate as it did when applied to the physical property of the railroad existing thereon.

Adjustment of Boundaries Essential to Consideration of Reproduction

Failure to take into account this adjustment of the boundaries of the abutting property to the railroad property, would render it impracticable to consider the cost of reproducing many existing railroads. The right of way of the Illinois Central along and near the lake front in Chicago is an instance of this kind.

It is not probable that any railroad would be allowed at this time to obtain a right of way and construct such a railroad through a district of the character which this railroad traverses in the city, neither would it be profitable to do so from an economical standpoint. Without considering the adjustment which has been going on since original construction between the abutting property and the railroad and its operation, consideration of reproduction would be entirely impracticable.

What the damage would be in the condemnation of such property and of the riparian right, if it had not become so adjusted, could only be a guess without basis of fact to support it, because a right of way for any considerable distance through property of this character has never been condemned in this country up to the present time.

A Fair Basis for the Valuation of Land

Justice Hughes in his opinion in the Minnesota Rate Case stated that if the railroads were allowed the present value of their land, as ascertained by the value of adjoining land, they would have no cause for complaint.

This view fails to take into account the fact that railroad land is acquired under necessity as to time and location, which factors **always** tend to make the cost of such land the maximum. It does not take into account the cost of acquisition, as by condemnation and other expensive methods.

If to the present value of the land, **established with reference to the necessity under which it must always be purchased,** and its **cost of acquisition,** there is added **the original amount which was paid on account of damage to land and improvements,** the railroads would be placed on a parity with other land owners as to its real estate values.

Valuation of Land Not Used for Railroad Purposes

The third paragraph of the Valuation Act provides as follows:

"Third. Such investigation and report shall show separately the property held for purposes other than those of a common carrier, and the original and present value of the same, together with an analysis of the methods of valuation employed."

In order to provide for future tracks, extensions of yards, terminals and other facilities, the railroads in some instances have acquired more land than their necessities demanded at the time of construction. In acquiring land it often costs less to buy an entire tract or parcel of land outright than to take only what is required and pay damage on the balance. Such lands are usually considered as held for common carrier purposes.

There arises at times a question whether certain lands owned by a railroad company may be reasonably considered as held for common carrier purposes. The purpose of this paragraph of the act is to ascertain what part of railroad lands is not so held, in order that its value may not be included in the inventory of property employed for transportation purposes.

The Director has asked the following questions in regard to such lands:

Director's Question (8): "When are lands 'owned or used' for common carrier purposes? Should lands in any case be classified as held for common carrier purposes unless they are actually so used?"

Lands are "owned or used" for common carrier purposes when they are directly employed in transportation and also where they are incidental to railroad operation. Land included within the right of way or other tracts of railroad property which is used for such purposes as storage, grain elevation,

stock yards, etc., even when the improvements thereon are constructed by another, is incidental to railroad operation and used for common carrier purposes.

In some instances, and particularly as to terminal real estate, it is good policy from the railroad standpoint, and in the interest of the public, that certain lands be purchased in advance of actual existing need.

The construction of terminals is usually followed by sharp advances in the price of adjoining lands, and such lands are often improved with very costly buildings and other improvements. When the growth of traffic demands the extension of facilities, the price of the land, and oftener the price of the improvements thereon, has become so large that it is not economically possible to construct urgently needed extensions.

Anticipation of reasonably expected future requirements is a cardinal principle of business policy and should be applied on a railroad as it is in other lines of business. For this reason, lands which are held by a railroad, which it may reasonably be supposed will be required within say, twenty-five years —a generation—should be included in the valuation. It is needless to say that such holdings should be subject to regulation, as some serious abuses might grow out of unregulated holdings of such property.

Intangible Value

The Valuation Act provides for ascertaining "Other Values and Elements of Value," that is, other values than that of the physical property. This evidently is intended to include not only the overhead charges mentioned, but certain other values which are termed "intangible values."

The term is used to classify all expenses that are preliminary to construction, such as legal expense of

organization, cost of franchises or permits, and in addition, the value of the property as a "going concern," of the "good will," if any, of the business, and the cost of such developments as have caused expenditure and yet do not show in the inventory.

The first of these have already been considered under the head of overhead expenses, and it remains to consider "good will," "going concern value" and "development."

As a preface to the following discussion, it may be well to state that the **courts** have very generally decided that these three elements have a value which should be included in the true value of the property, but that the railroad commissions of the various states have usually decided that nothing is to be allowed for the three items except such expenditures as may be shown from the records were actually incurred in developing the business, and which do not show in any way in the inventory of physical property.

Good Will

The term "good will" has been defined by Lord Elden, the English authority, as "nothing more than the probability that the old customers will resort to the old place * * * that it involves an element of personal choice and is **inappropriate where there can be no choice** and therefore should be given no value."

English syndicates, in purchasing manufacturing properties in the United States, have often expressed the value of good will in terms of net earnings produced in a certain number of years. After valuing the physical property, the value of the good will which is to be added will be the sum of the net earnings for the three to five consecutive years immediately preceding the sale.

It has been very generally assumed that, as to

the greater part of its business, most railroads enjoy a monopoly. If this were true, there would be no "good will" value in the business, as its customers would have no choice of doing or refusing to do business with it. As a matter of fact, this is far from the true situation, as only a very small percentage of the business of most railroads is free from competition.

It will be admitted at once, that on the bulk of the through business between points distant from each other, there is usually competition as to the whole or greater part of the distance. What is not so evident is that class of business shipped from a station served only by one road to a market which has more than one road serving it.

While the shipment may be non-competitive in the sense that the shipper has no choice of roads, the **commodity** itself comes into competition with **like commodity** hauled by other roads into the same market. In consequence, the business is competitive in spite of the fact that the shipper has no choice, for the road must make such rates and give such service that he may compete with other shippers located on other roads.

While the shipper has no choice of roads, he has the option of going into the business or staying out of it, and his decision is based on the rates and services of the road and therefore there is an element of good will in that class of traffic. The following will serve to illustrate this principle:

The Chicago & Eastern Illinois Railroad serves the coal mines in the Brazil district of northern Indiana; the C., C., C. & St. L. Railroad serves the coal mines in southern Illinois. The principal market for the mines of both districts is Chicago. The mines located on the C. & E. I. Railroad have only that road to ship over in reaching their market, and the same

is true as to mines on the C., C., C. & St. L. Railroad. However, if the C., C., C. & St. L. Railroad does not make a rate for carrying coal to Chicago low enough to place the product of the mines on its line on a parity in the Chicago market with the product of the mines located on the C. & E. I. it gets no business at all.

In other words, in carrying coal to Chicago it competes with the C. & E. I. Railroad, in spite of the fact that neither of the shippers has a choice of railroads over which to ship, but each coal operator has the option of choosing on which road he will locate, or of deciding whether or not his coal will be mined and shipped, and his decision will be based on the respective rates and service available from each company.

It may be stated, therefore, as a general proposition, that except as to that small percentage of shipments moving between local stations on a railroad, the entire business of the railroads is competitive, and for this reason they are entitled, when the actual conditions warrant it, to a value for the good will of their business, in the same manner and to the same extent that any mercantile business is.

Going Value

The following definitions, both legal and otherwise, of the term, "going value," or "going concern value," are quoted to convey the idea that this term implies:

"The sum (going concern value) we understand to be an expression of the added value of the plant as a whole over the sum of its component parts, which is attached to it because it is in active and successful operation and earning a return." (Justice Moody, in the Knoxville Water Company Case.)

"It is the value such a plant has over and above its physical value, due to the fact that it is not a

bare and idle system, but it is in actual operation, doing business with a large number of customers. It is something like the good will of a business, but it is even more tangible." (The late William H. Bryan, Consulting Engineer.)

"The city steps into the possession of a property which not only has the **ability to earn,** but **is, in fact, earning.** It should pay, therefore, not merely the value of a system which **might** be made to earn, but that of a system which **does earn."** (Justice Brewer in Kansas City Waterworks Case, 62 U. S. Fed. Rep. 853.)

"The value of the structure is enhanced by the fact that it is being used in, and in fact is essential to, a going concern business. We speak sometimes of a going concern value as if it is or could be separate and distinct from structure value—so much for structure and so much for going concern. But this is not an accurate statement. The going concern part of it has no existence except as a characteristic of the structure. If no structure, no going concern. If a structure in use, it is a structure whose value is affected by the fact that it is in use. There is only one value. It is the value of the structure as being used. That is all there is of it." (Judge Savage, in Brunswick and Topham Water Districts vs. Maine Water Company.)

The following decision of the Wisconsin Railroad Commission, in the case of Payne and others of Marinette against the Wisconsin Telephone Company, illustrates a rather different phase of this value than those just quoted.

The losses incurred during the first years of operation may be considered either as the cost of establishing a going business or a development expense. The distinction between these two elements is not always clear. It is given here as illustrating the fact

that some rate-regulating commissions have recognized the justice of allowing for the cost of establishing public utility corporations on a paying basis; that is, giving them a value as a going concern:

"If property is devoted to the public use and reasonable care has been exercised in all the phases of its management, but the owners have not yet received a fair return during the earlier years of the operation of the plant in which the property is used for the convenience of the public, the deficits thus incurred must be made up out of later earnings, in so far as that is commercially possible and expedient. * * *

"The Commission holds that the actual wise expenditure of money toward getting the business of the plant established may be included in the value to be allowed for the purpose of fixing rates."

Most of the decisions and opinions just given relate to cases in which municipalities or districts have condemned waterworks, owned by private corporations, which it was desired to bring under public ownership, and to telephone systems. The nature of the business of supplying water and telephones is more nearly monopolistic certainly than the business of transportation, as has been shown in the previous discussion.

In view of the decisions of the United States Supreme Court, of the highest State courts and the opinion of eminent engineers, and in one case, at least, of a State Commission, it is difficult to escape the conclusion that railroads should be allowed a going concern value when their properties are to be evaluated. If the valuation is to be made the basis for purchase, there can be no question of the justice of such an addition to physical value, nor does it seem unreasonable in a valuation made as a basis for fixing rates.

To include only the physical property and the overhead charges heretofore mentioned in making the valuation, omitting the commercial value of the system, leads to illogical conclusions when applied to the various railroad systems of the country as they actually exist. To illustrate the point: Consider two trunk lines extending from Chicago to New York —the Erie and the New York Central.

The Erie Railroad through southern New York, northwestern Pennsylvania and northern Ohio, crosses some very rough country topographically, involving large expenditures for grading the roadbed and some sharp curvature and heavy grades in overcoming the divides which it crosses.

The New York Central follows the valleys of the Hudson and Mohawk rivers practically to the shores of Lake Erie, whence it traverses the flat level lake plains into northern Ohio. As to the greater part of the distance, the cost for grading its roadbed has been small, its grades are light, and except as to a portion of the line along the Hudson river, there is little curvature. Its distance between the termini is twenty miles less than that of the Erie. It has on its main line such cities as Albany, Utica, Syracuse, Rochester, Buffalo, Cleveland and Toledo, which the Erie reaches only over branch or connecting lines or not at all.

The cost of reproducing the Erie (track for track) will be very much larger than the cost of reproducing the New York Central, if only the physical property and overhead charges are included in the valuation. To say that it has equal value considered from a commercial standpoint is ridiculous.

The real difference in value, from a commercial standpoint, is made up of the larger going value of the New York Central, which is based largely on good service, favorable topography and strategical position. Establishing the value simply on the basis

of the component physical parts of a railroad is evidently illogical, whether the valuation is to be the basis for purchase or rate-making.

Early Deficits an Element of Going Value

The cost of establishing a railroad on a paying basis may be considered either as an element of the cost of going value or as a development expense. It is treated here as one of the elements of going value.

Immediately after a railroad is constructed, its earnings are practically nothing at all. Under very favorable circumstances it may earn its operating expenses and fixed charges in three or four years. Experience shows, however, that ordinarily a much longer period of time is required. The greater part of the railroads of the country—as to mileage—have gone into the hands of a receiver within the ten-year period following their completion. On the larger systems, with a large mileage in successful operation, extensions have been made which did not get into court, but their operation usually entailed a loss for the parent system during their earlier history.

Stated in another way, the cost of placing most of the railroads on a paying basis has been deficits in receipts as compared with expenses and charges and the lack of profit during a considerable period of their earlier operation. A railroad, therefore, which is able to pay its expenses, charges and a profit is a more valuable property than is represented by the reproduction cost of its physical component parts, and the measure of such increased value is certainly as great as its cost.

In consequence, to the value of the reproduction cost, with overhead charges included, there should be added the deficits of the early years of operation and a fair profit for such operation. This is as

much a part of the cost of producing a going railroad as labor, material, use of money, or any other element of value which has found its way into the working whole.

Development Cost

As used in this discussion, development expenses are intended to cover that class of expenditures which were necessary in bringing the railroad to its present state of efficiency, but the **physical property** for which the expenditure was made does not appear in the inventory of the property as it is operated at the present time.

In the chapter on "Construction and Re-Construction," the manner in which railroads have been first constructed and the necessity for their re-construction later has been explained in detail. It is the general impression of the public, and of many railroad men, that the re-construction of the railroads has been necessitated by errors made in locating the original line, or in constructing it. Nothing could be further from the truth.

The original locations were based on financial necessity and the undeveloped condition of the country traversed; the temporary original construction was necessitated by the excessive cost of permanent work in districts without transportation—with financial necessity added. As stated in the chapter referred to, it was oftener a question of whether the railroad could be constructed at all rather than as to what kind of railroad was to be constructed. The stiff grades and sharp curvature employed on the original roads were necessities, not mistakes, and their employment indicated skill and sound business judgment on the part of the engineers.

Had the railroads been first constructed to the present-day standards as to grades, curvature and

character of structures, only a very small part of the present extensive system of railroads could have been constructed or, if constructed, operated except at enormous losses. The meager available capital and the certainty of limited traffic during the period following construction would have forbidden it.

The economics of operation for an increased traffic density necessitated the re-construction of the railroads, and in such re-construction much of the original construction had to be abandoned. Remembering that the original line was absolutely essential in producing the business which the reconstructed line carries at the present time, a part of its cost is properly a part of the cost of the line as it now exists, although no item would appear in an inventory of the present line to cover it.

Permanent Structures Only to Be Included

There are certain items of the cost of the original line which cannot properly be included—namely, those items which are in constant course of renewal, the cost of which renewal is included in operating expenses—but those items which are capital charges, not subject to renewal at operating expense, may properly be included in the estimate for cost of development due to abandoned lines.

The rails and steel bridge superstructure on abandoned lines may be removed and used in other situations or sold for scrap; the ties, timber bridges, frame station and other buildings, fences, etc., are temporary structures and things with comparatively short life, renewable from operating expense.

No structure or thing of this character should be included in the estimate of development expense, but excavations and embankments, masonry bridge piers and culverts, culvert pipes of tile or iron, and all other permanent structures, not removable from

an abandoned line, should be included in this estimate.

Other Provisions of the Act

The fourth paragraph of the Valuation Act provides for an investigation and report upon the history and organization of present and previous corporations operating the railroad property.

The fifth paragraph of the act provides for a report of the amount and value of any gift or grant of right of way, or donation made to the railroads by the United States or other Government (State, County or Municipal), or by individuals or corporations; also the grants of land to them by the United States or other Governments, and the amount of money derived from the sale of such grants and the value of the unsold portion at the time acquired and the present time; also the amount and value of concessions and allowances made by the railroads to the United States or other Governments, in consideration of such aid, gifts, grants or donations.

During the earlier periods of railroad construction, the Federal Government, and some of the states, made very extensive grants of unoccupied and other lands, to encourage the building of railroads into undeveloped territories, particularly west of the Mississippi River.

In some instances the railroad was given each alternate section of land (a section of land is one mile square and contains 640 acres of land) for a certain distance on each side of its line. The railroads have sold a part of the land so granted and retain some of it.

A portion of these lands have become valuable through the subsequent discovery of coal or other mineral under them, or through the increased value of timber on such lands.

This paragraph of the law provides for a statement of all lands granted the railroads and an inventory of such land still held by them, together with the value of such land at the time it was granted and the present time.

It also provides for a statement of the value of the concessions in reduced rates and free transportation made by the railroads to these governments on account of their grants of land and other aid.

The purpose of these two statements and reports is evidently to compare the value of the grants made by the governments with the value of the rate concessions made by the railroads.

The act provides that the Interstate Commerce Commission shall prescribe the procedure and the form and classification of the items of the valuation; requires the railroads to furnish any data required by the Commission; provides for the maintenance of the valuation after it has been made and for a hearing of protests by interested parties of any valuation made under the supervision of the Commission.

Conclusions

Based on the discussions contained in this chapter, the following are fair conclusions as to the items which are to be included and the methods to be employed in evaluating railroad property:

(1) That as to all physical structures—such as track, buildings of all kinds, water and fuel stations, fences, excavations, embankments and all rolling stock—engines and cars—machinery, tools and all equipment of any kind essential to the operation and maintenance of the railroad, the cost of reproduction new is the fair value of the physical property at the time of valuation.

(2) That deterioration in a simple component part of a railroad is depreciation **in that particular**

part, but is not, necessarily, depreciation in the **property or plant as a whole.**

If the simple parts of a railroad are maintained at the standard required for economical operation and worn parts are replaced when they have come to the end of their useful life, there is no depreciation of the railroad as a whole.

If proper maintenance is not applied to the simple parts of a railroad and replacement of worn parts made when due, there is depreciation in the property as a whole, and the cost of making good the deferred maintenance and applying the replacements due is the measure of the depreciation in the railroad as a whole.

(3) The cost of maintaining and replacing the simple component parts of a railroad is a part of the current expense of operating it, and has no connection with the capital account or the present true value of the property, so long as the railroad as a whole is properly maintained for economical operation.

In consequence, if the cost of restoring that portion of depreciation which is properly to be overcome by expenditure for operating expense is deducted from the capital or the present true value of the railroad, such deduction confiscates the property of its owner if such alleged true value is used as a basis for determining the justice of rates.

(4) That the factors of necessity as to time and location must be considered in establishing the value of railroad real estate, and the cost of acquisition must be included therein, as well as the original amount actually paid (or estimated) for damage to adjacent land and improvements, if the owners of the railroad land are to be placed on a parity with other land owners.

If the cost of reproduction new of the land is to be found, consideration must be given to the adjustment of the boundaries of abutting land to the lands of the railroad which has occurred since the time of original construction.

Where the line of the proposed reproduced railroad would divide the parcel or tract of land of any owner, consequential damage to land and improvements not taken must be considered and allowed as a part of the cost of reproduction.

(5) That certain percentages—to be determined as far as possible from the available records of the railroad under valuation, supplemented by general experience, where such records are incomplete—be added for overhead charges, viz., Engineering and General Expenditures.

(6) That a percentage be added for Contingencies, the amount to be determined by the character of the work being valued.

(7) That an amount be added for Interest during construction, equal to the interest on the whole cost of all items, except equipment, for a period of time equal to one-half the estimated time required for construction, at the average rate which the particular railroad under consideration has paid for capital or borrowed money, during the ten-year period preceding valuation—or during the first half of the decade.

(8) That an amount be added for good will and going value, the minimum being the aggregate of all deficits in operating expenses and fixed charges and lack of profits occurring between the completion of the railroad and the time at which it returned a profit on the actual value of the property.

This minimum is to be determined from the records of the corporation, when these are available,

or estimated on the basis of the recorded experience of roads similarly situated when they are not.

That other elements of going value be considered on each system particularly.

(9) That for the embankments, excavations, masonry, permanent culverts and other non-removable, permanent structures on abandoned lines, their cost be added to the value of the existing operated lines as a development cost.

(10) As a corollary of (8) and (9), the total **commercial value** of a railroad does not necessarily bear a direct relation to the cost of reproducing its physical property or the amount of its capitalization.

(11) That the Federal Valuation, now being made, will affect the credit of the railroads advantageously, if based on the same principles as are applied in determining other commercial values.

Current depreciation is an inevitable accompaniment of railroad operation. If it is to be deducted from capital or present value (the investment being impaired), an investor in railroad securities is assured, in advance, of a large shrinkage in the value of his investment. If depreciation (other than deferred maintenance) is deducted from reproduction cost, to determine present value of railroad property, and the public come to regard such value as the intrinsic worth of the property, **and the amount on which railroads will be allowed to earn a fair return,** railroad borrowing for the purpose of providing extensions and betterments of existing railroads will be practically barred.

RATES

Basis of Rate Making

Railroads were first opened to public use in England in 1830. From the speeches in the English Parliament in 1836 to the present moment, the discussion of the proper basis for rate making has been persistent. Speaking broadly, there are two possible methods of making rates: (1) One based on Cost of Service and (2) the other based on Value of Service. There is in addition, of course, a basis combining both methods and other conditions.

It may be said, in advance of the following discussion, that all tariffs of railway rates, in all countries, whether the railways be owned and operated by the State or by private corporations, always have been, now are, and, so far as students of the matter are able to judge, always will be based on the second method, in combination with other conditions, **limited in all cases, as to the minimum charge, by cost of service.**

In a matter of such vital public interest, however, it is well to understand the reasons for the adoption of any particular method rather than another, especially in these days, when many subjects heretofore considered settled finally are being re-investigated, tested and adapted to a changing economical and social condition.

Cost of Service

The schedule of railroad rates **as a whole** must provide for:

(1) Cost of Conducting Transportation.

(2) Cost of maintaining Roadbed, Structures and Equipment.

(3) Payment of interest on investment (on capitalization or valuation), rentals, taxes and all other fixed charges.

(4) Profit to the operators of the transportation facilities.

Cost of Service involves consideration of Capitalization, Valuation, Expenditures for Operating Expense and Income. These several subjects will be discussed in turn.

Capitalization

The total length of line of railroads of the United States reported by the Interstate Commerce Commission in 1914, representing more than 98 per cent of the entire mileage of the country, is nearly 250,000 miles, the total capitalization nearly $16,000,000,000, the actual average capitalization per mile being $66,661.

As to the real value of the property, compared with its capitalization, it may be said of the railroads, **as a whole,** that the valuation now being made by the Interstate Commerce Commission will probably show a larger gross amount than the total capitalization, judging from the results obtained by independent valuations which have been made heretofore.

For the purpose of this discussion, then, the two terms, capitalization and valuation, may be regarded as synonomous. It must be remembered, however, that as to particular roads, the valuation will in some cases exceed and in others be less than the capitalization, as explained in the chapter on Valuation. Certain relations between valuation and rates are discussed in succeeding pages.

It has cost much to construct railroads, and, in comparison with such cost, little to maintain them.

For the whole country the capital is nearly 16 billion dollars, the annual maintenance cost,* nine hundred and fifty million dollars, or practically six per cent of the capital cost.

The profit of any business depends largely on the extent to which its facilities are kept constantly employed. A railroad can not employ its facilities fully, except on the main trunk lines—and only at times as to them.

With a volume of traffic nearly equal to its capacity, the receipts of a railroad will be relatively high, as compared with its capital, and in consequence the charge for capital will be light per unit of traffic, or, stated concisely, **the greater the volume of traffic the smaller the capital charge per unit of traffic.** The exception to this is that immediately after additional tracks or other facilities are constructed, even with a greater density of traffic, the cost per unit may be greater for a time, as the increased capital charge is spread over traffic but slightly increased.

On branch and secondary main lines, even though the **capitalization per unit of length** (as per mile) is less than that of main trunk lines—on account of lower standards as to grades and other items affecting the cost of construction in a large measure—the **capital cost per unit of traffic** is greater on account of less density of traffic. For this reason, such branch and secondary main lines should be allowed to charge higher rates per unit of traffic than obtain on lines of dense traffic.

The following table, compiled from the 1913 statistics of the Interstate Commerce Commission, will illustrate the fact that the capitalization **per unit of traffic** is less as the traffic density increases:

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*Maintenance of roadway, structures and equipment.

Railroads	Capital per Mile of Line in Dollars.	Traffic Units* per Mile of Line in Thousands.	Capital† per Unit of Traffic in Cents.
Pennsylvania Railroad..	163,192	6,160	2.72
Illinois Central........	66,389	1,700	3.90
Louisville & Nashville..	51,727	1,260	4.10
Atch., Top. & Santa Fe..	57,131	904	6.32
Atlantic Coast Line....	43,121	528	8.17
Manistee & N. Eastern..	18,455	174	10.58

*Traffic Units, as employed in this discussion, are passenger miles plus freight ton-miles.

†Capital per Unit of Traffic is capital per mile in first column divided by Traffic Units of second column.

This table shows that on systems of light traffic and on branch lines, the portion of the total cost of service which relates to the payment of interest on capital, that is, fixed capital charges, is greater per unit of traffic than on roads with dense traffic. The Pennsylvania, with a capital per mile nine times as large as the Manistee & North Eastern, has only 26% as much capital **per unit of traffic** as the latter road—that is, the cost for capital **per traffic unit** on the Manistee & North Eastern is four times as great as on the Pennsylvania.

Relation of Traffic to Operating Expense General

In order to understand some phases of the economics of rates, certain relations which exist between Traffic and Operating Expense must be understood. It does not cost as much per unit of traffic to haul long distances as it does shorter ones. It costs less per unit to haul traffic when 5 million tons per mile of line are moved than when 1 million tons per mile of line are moved.

This is true beyond dispute, for the statistics of actual operation show it clearly. But the reasons

why it is true and, what is more essential to know, **how much** less it does cost, cannot be understood except by making a detailed analysis of operating expense for different traffic conditions. Fortunately for the investigator, there is sufficient authentic data available for the purpose of general analysis.

Interstate Commerce Commission Statistics

The Interstate Commerce Commission since 1887 has required the railroads to make reports to it of their operating expense. These are made on prescribed forms by over 98% of the railroads in the United States.

One form for large roads—that is, roads whose annual revenues are in excess of $1,000,000—divides operating expense into five main classes, which are subdivided into 117 subitems. The other form for small roads—roads whose annual revenues are between $100,000 and $1,000,000—divides the expense into five main classes, which are subdivided into 44 subitems.

These statistics, based on uniform classification of all items of operating expense, furnish the data necessary in making an analysis of it. They are used by engineers in analyzing the effects of distance, grades, and curvature on operating expense, and are applied practically to the location and construction of railroads; by the operating department in investigating the efficiency of its organization in managing the property, and they should be employed in determining the true relation which exists between traffic and operating expense.

In the following table, the five main classes into which operating expense is divided are shown at the head of the columns and the relation which each class of expense bears to the total operating expense is shown by percentages for a period of seven years.

The figures are the average of all roads of the country reporting to the Interstate Commerce Commission.

What this table means, simply stated, is that of each dollar spent by the average railroad for operating, a little more than 19 cents is spent on account of maintaining the track, bridges, buildings, and other structures of the company; that about 23 cents of each dollar is spent on account of maintaining locomotives, cars, and shop machinery used in repairing or renewing them; that 3 cents is spent by the Traffic Department in securing and looking after the traffic moved; that 51 cents is spent in providing train and switching crews, station employees, fuel, lubricants, and water for engines, and other things required in actually moving the trains; that 4 cents is spent for paying the salaries and office expense of general officers, for insurance, pensions and similar items.

Main Divisions of Operating Expenses

Showing percentage of each class to total.

Year.	(1) Maint. of Way. Per Cent.	(2) Maint. Equip. Per Cent.	Traffic. Per Cent.	Transportation. Per Cent.	General Expenditure. Per Cent.
1908	19.73	22.06	2.89	52.01	3.31
1909	19.29	22.75	3.08	50.90	3.98
1910	20.22	22.66	3.07	50.29	3.76
1911	18.87	22.54	3.12	51.75	3.72
1912	18.35	23.02	3.11	51.87	3.65
1913	19.24	23.70	2.91	50.63	3.52
1914	19.13	24.13	2.89	50.02	3.83
Average .	19.22	22.99	3.02	51.08	3.69

(1) Maintenance of Way and Structures.
(2) Maintenance of Equipment.

The table shows that the percentage which each class of expense bears to the total operating expense is very nearly uniform from year to year.

The following tables** show the percentage which each one of the 117 **items** of expense bears to the total operating expense for the year ended June 30, 1914. For instance, 3 cents of the average railroad dollar was spent in renewing ties; nearly 7 cents for keeping up the roadbed and track; a little more than 8 cents for repairing locomotives; 8½ cents for repairing freight cars; about 6 cents to pay locomotive engineers; 9½ cents for furnishing the road engines with coal; and so on through the list, the **relative** expense for each item is shown.

Summary showing classification of operating expenses for the year ending June 30th, 1914, and proportion of each class to the total.—Large Roads*

Operating Expense

Item No.	Maintenance of Way and Structures	Per Cent of Total Operating Expense
1.	Superintendence of way and structures	0.977
2.	Ballast	.332
3.	Ties	3.074
4.	Rails	.875
5.	Other track material	.987
6.	Roadway and track	6.846
7.	Removal of snow, sand, and ice	.266
8.	Tunnels	.051
9.	Bridges, trestles, and culverts	1.685
10.	Over and under grade crossings	.071
11.	Grade crossings, fences, cattle guards and signs	.329
12.	Snow and sand fences and snowsheds	.021
13.	Signals and interlocking plants	.546
14.	Telegraph and telephone lines	.217
15.	Electric power transmission	.037
16.	Buildings, fixtures and grounds	1.747
17.	Docks and wharves	.152
18.	Roadway tools and supplies	.249
19.	Injuries to persons	.144
20.	Stationery and printing	.037
21.	Other expenses	.011
22.	Maintaining joint tracks, yards and other facilities—Dr.	.773
23.	Maintaining joint tracks, yards and other facilities—Cr.	.561
	Total maintenance of way and structures	18.866

*Roads having annual earnings in excess of $1,000,000.

**These tables show the average for all roads reporting to the Interstate Commerce Commission.

Item No.		Per Cent of Total Operating Expense
	Maintenance of Equipment	
24.	Superintendence of equipment	.704
25.	Steam locomotives—repairs	8.183
26.	Steam locomotives—renewals	.132
27.	Steam locomotives—depreciation	1.027
28.	Electric locomotives—repairs	.036
29.	Electric locomotives—renewals	.....
30.	Electric locomotives—depreciation	.012
31.	Passenger—train cars—repairs	1.523
32.	Passenger—train cars—renewals	.050
33.	Passenger—train cars—depreciation	.298
34.	Freight—train cars—repairs	8.510
35.	Freight—train cars—renewals	.597
36.	Freight—train cars—depreciation	2.004
37.	Electric equipment of cars—repairs	.014
38.	Electric equipment of cars—renewals	*
39.	Electric equipment of cars—depreciation	.007
40.	Floating equipment—repairs	.044
41.	Floating equipment—renewals	.003
42.	Floating equipment—depreciation	.019
43.	Work equipment—repairs	.228
44.	Work equipment—renewals	.038
45.	Work equipment—depreciation	.079
46.	Shop machinery and tools	.546
47.	Power plant equipment	.018
48.	Injuries to persons	.117
49.	Stationery and printing	.054
50.	Other expenses	.025
51.	Maintaining joint equipment at terminals, Dr	.087
52.	Maintaining joint equipment at terminals, Cr	.044
	Total maintenance of equipment	24.311

*Less than 0.001 per cent.

	Traffic	
53.	Superintendence of traffic	.765
54.	Outside agencies	1.137
55.	Advertising	.379
56.	Traffic associations	.071
57.	Fast freight lines	.154
58.	Industrial and immigration bureaus	.082
59.	Stationery and printing	.320
60.	Other expenses	.006
	Total traffic expenses	2.914

	Transportation	
61.	Superintendence of transportation	1.256
62.	Dispatching trains	.845
63.	Station employes	6.886
64.	Weighing and car-service associations	.117

Item No.		Per Cent of Total Operating Expense
65.	Coal and ore docks	.176
66.	Station supplies and expenses	.574
67.	Yardmasters and their clerks	.850
68.	Yard conductors and brakemen	2.830
69.	Yard switch and signal tenders	.213
70.	Yard supplies and expenses	.079
71.	Yard enginemen	1.637
72.	Enginehouse expenses—yard	.524
73.	Fuel for yard locomotives	1.570
74.	Water for yard locomotives	.109
75.	Lubricants for yard locomotives	.030
76.	Other supplies for yard locomotives	.035
77.	Operating joint yards and terminals—Dr	1.332
78.	Operating joint yards and terminals—Cr	.793
79.	Motormen	.048
80.	Road enginemen	5.947
81.	Enginehouse expenses—road	1.729
82.	Fuel for road locomotives	9.423
83.	Water for road locomotives	.617
84.	Lubricants for road locomotives	.175
85.	Other supplies for road locomotives	.191
86.	Operating power plants	.058
87.	Purchased power	.048
88.	Road trainmen	6.415
89.	Train supplies and expenses	1.843
90.	Interlockers and block and other signals—operation	.532
91.	Crossing flagmen and gatemen	.360
92.	Drawbridge and operation	.049
93.	Clearing wrecks	.267
94.	Telegraph and telephone—operation	.296
95.	Operating floating equipment	.145
96.	Express service	.002
97.	Stationery and printing	.425
98.	Other expenses	.129
99.	Loss and damage—freight	1.555
100.	Loss and damage—baggage	.014
101.	Damage to property	.204
102.	Damage to stock on right of way	.190
103.	Injuries to persons	1.233
104.	Operating joint tracks and facilities—Dr	.284
105.	Operating joint tracks and facilities—Cr	.257
	Total transportation expenses	50.192

General

106.	Salaries and expenses of general officers	.481
107.	Salaries and expenses of clerks and attendants	1.542
108.	General office supplies and expenses	.182
109.	Law expenses	.564
110.	Insurance	.350
111.	Relief department expenses	.034

Item No.		Per Cent of Total Operating Expense
112.	Pensions	.174
113.	Stationery and printing	.159
113½.	Valuation expenses	.078
114.	Other expenses	.122
115.	General administration, joint tracks, yards and terminals—Dr.	.046
116.	General administration, joint tracks, yards and terminals—Cr.	.015
	Total general expenses	3.717

Recapitulation of Operating Expenses

1.	Maintenance of way and structures	18.866
2.	Maintenance of equipment	24.311
3.	Traffic expenses	2.914
4.	Transportation expenses	50.192
5.	General expenses	3.717
	Total operating expenses	100.000
	Ratio of operating expenses to operating revenue	72.048

Summary showing classification of operating expenses for the year ending June 30, 1914, and proportion of each class to the total.—Small Roads*

Operating Expense

Item No.	Maintenance of Way and Structures	Per Cent of Total Operating Expense
1.	Superintendence of way and structures	1.268
2.	Maintenance of roadway and track	19.182
3.	Maintenance of track structures	3.972
4.	Maintenance of buildings, docks and wharves	1.500
5.	Injuries to persons	.108
6.	Other maintenance of way and structure expenses	.536
7.	Maintaining joint tracks, yards and other facilities—Dr.	.681
8.	Maintaining joint tracks, yards and other facilities—Cr.	1.494
	Total maintenance of way and structures	25.753

Maintenance of Equipment

9.	Superintendence of equipment	.974
10.	Locomotives—repairs	6.230

*Roads having earnings between $100,000 and $1,000,000 annually.

Item No.		Per Cent of Total Operating Expense
11.	Cars—repairs	7.331
12.	Floating equipment—repairs	.036
13.	Work equipment—repairs	.197
14.	Equipment—renewals	.483
15.	Equipment—depreciation	3.786
16.	Injuries to persons	.068
17.	Other maintenance of equipment expense	.631
18.	Maintaining joint equipment at terminals—Dr.	.037
19.	Maintaining joint equipment at terminals—Cr.	.059
	Total maintenance of equipment	19.714
	Traffic	
20.	Traffic expenses	2.317
	Transportation	
21.	Superintendence and dispatching trains	2.138
22.	Station service	7.340
23.	Yard enginemen	.908
24.	Other yard employees	1.637
25.	Fuel for yard locomotives	1.303
26.	All other yard expenses	.419
27.	Operating joint yards and terminals—Dr.	1.265
28.	Operating joint yards and terminals—Cr.	.971
29.	Road enginemen and motormen	5.949
30.	Fuel for road locomotives	11.196
31.	Other road locomotive supplies and expenses	2.979
32.	Road trainmen	6.640
33.	Train supplies and expenses	1.114
34.	Injuries to persons	1.091
35.	Loss and damage	.648
36.	Other casualties	.668
37.	All other transportation expenses	1.557
38.	Operating joint tracks and facilities—Dr.	.472
39.	Operating joint tracks and facilities—Cr.	.750
	Total transportation	45.603
	General Expenses	
40.	Administration	5.529
41.	Insurance	.674
42.	Other general expenses	.535
43.	General administration, joint tracks, yards, and terminals—Dr.	.034
44.	General administration, joint tracks, yards, and terminals—Cr.	.159
	Total general expenses	6.613

Fixed Operating Expense

An examination of the 117 items into which Operating Expense is divided in the first table will show that some of the items are not affected at all by the amount of traffic carried, some are directly proportional to it, and some are only partly affected. If we analyze the effect which traffic has on each item, we will be able to say definitely what part of the expense is dependent on the volume of traffic and what other part is independent of it, or, in other words, there are certain fixed expenses which would be incurred whether the volume of traffic moved was 100,000 or 1,000,000 tons per mile of line.

Maintenance of Way Expense

The American Railway Engineering Association, composed of engineers engaged in the construction and maintenance of railways, have investigated thoroughly what factors have an effect on the operating expense of maintaining the roadway and structures.

The committee of the association investigating this special matter reported that of the 23 items of maintenance of way expense, 7 were affected by the volume of the traffic and the balance were not. The items affected are Superintendence, Ties, Rails, Other Track Material (rail fastenings, switches, etc.), Roadway and Track (principally section labor), Buildings, Tools and Supplies.

The maintenance expense on account of ties is due to two causes—decay and mechanical wear. The amount due to mechanical wear is proportional to the volume of the tonnage of the trains. Using the average volume of tonnage for all "Large Roads" for 1914 and the factors for determining maintenance expense due to mechanical wear, as found by the association named, the average cost of mainte-

nance of ties due to age and decay is 80%, and for maintenance caused by the traffic, 20%.**

The operating expense on account of rails is due to corrosion, and wear from train operation. The effect of corrosion on expense is very small and the whole expense of rail maintenance may be charged against the traffic. The same is true of "Other Track Material."

Using the factors determined by the engineering association before referred to, 50% of the expense of Superintendence, Roadway and Track and Roadway Tools and supplies are due to the volume of traffic.

Maintenance cost of buildings is not appreciably affected by volume of traffic. It is evident that the cost of maintenance for such items as Removal of Snow, Bridges and Culverts, Telegraph and Telephone, Grade Crossings, Fences and Cattle Guards, and the balance of the 23 items in this class are not affected at all by the volume of traffic, the expense being the same whether 1 or 10 trains per day are operated.

We can now show what portion of maintenance of way expense is affected by the traffic and the balance is a fixed operating expense which is incurred independently of the volume of traffic carried.

Item No.	Item.	Per Cent Affected by Traffic.	Percentage of Total Operating Expense*	Percentage of Total Operating Expense Due to Traffic.
1	Superintendence	50%	0.977	0.488
3	Ties	20%	3.074	0.615
4	Rails	100%	0.875	0.875
5	Other Track Material.	100%	0.987	0.987

**This will vary with roads of different traffic density and differing class of ties.

*Average for all large roads of the country as shown by a preceding table.

6	Roadway and Track..	50%	6.846	3.423
18	Road-way Tools and Supplies	50%	0.249	.125
	Percentage of Total Operating Expense due to Traffic..................			6.513

The total for all items of maintenance of way expense is 18.866, as shown by a preceding table, which determines the fact that 66% of all maintenance of way expense is a **fixed expense** ($\frac{6.513}{18.866}$) and that only 34% of it is due to the volume of traffic. This is of very great importance in connection with rate-making; its application will be shown later.

Maintenance of Equipment Expense

Continuing the analysis of the next class of Operating expense items, Maintenance of Equipment, we find that all of the operating expense items are dependent on the volume of traffic moved, except a part of the expense of repairs, renewals, and depreciation of locomotives (items 25-27)†, passenger-train cars (31-35), freight-train cars (34-36), and work equipment (43-45).

A careful analysis of these items of repairs, renewals, and depreciation of equipment was made by Wellington* from the records of several large railroad systems. He found that the cost of painting and other work on locomotives, which is due to age, weather, and other conditions not dependent on traffic, was 7% of the maintenance cost.

About 50% of the cost of passenger car repairs is for painting and other items which are due to age

†These numbers refer to the Item Number in the table showing the classification of items of operating expense.

*"Economic Theory of Railroad Location," by A. M. Wellington, C. E.

and not therefore dependent on volume of traffic. A large part of the expense of maintaining freight and work cars is due to painting and to the decay of the wood of which they are largely constructed. If we take 30% of the maintenance cost as due to age, and therefore independent of the traffic, we will be very near the truth.

Tabulating this data we have:

Item No.	Item.	Percentage not Affected by Traffic	Percentage of Total Operating Expense	Percentage of Total Operating Expense not due to Traffic
25-27	Steam Locomotives...	7%	9.342	0.654
31-33	Passenger-Train Cars.	50%	1.871	0.936
34-36	Freight-Train Cars...	30%	11.111	3.333
43-45	Work Equipment....	30%	0.335	0.101

Percentage of Total Expense **not** due to Traffic 5.024

Dividing this 5.024 by 24.311, the total for all items of equipment operating expense, we have 20.7% (say, 20%) of the total maintenance of equipment expense due to other causes than the traffic.

Expense of Conducting Transportation

Of the 45 items of expense due to Conducting Transportation all except 14 are directly affected by an increase in volume of traffic.

On such items as the wages of enginemen, trainmen, switchmen, fuel, water, and lubricants for locomotives, which make up the larger part of transportation expense, an increase in volume of traffic increases the expense almost in direct proportion. On the 14 items, however, certain portions of the expense will be incurred independent of the volume of traffic moving.

The percentages used in the following are approximations only, as an accurate division of the expense can not be made between the fixed expense and that varying with the traffic. Such approximations are, however, very near the truth and will answer every purpose for which the data is to be employed.

Superintendence of transportation (item 61) is only partly increased by increased volume of traffic—that is, there is a certain amount of supervision needed whether the traffic density is 2 million tons per mile of line or four million. The same is true of Dispatcher's forces (62), as there might be a considerable addition in volume of traffic (and therefore number of trains) without increasing the force employed.

Station employees' (63) expense is made up in greater part of salaries and expenses at smaller stations. Considerable increases of traffic would not affect such expense. The expense at terminal stations where many laborers are employed varies more nearly with the traffic but does not increase in direct proportion to it, as certain employees, such as the agent and the larger part of his office force, must be retained irrespective of the volume of business.

If we say that for Superintendence, Dispatching, Coal and Ore Docks, and Station Employees, 75% of the expense is not affected by increases in the volume of traffic, we are very near the truth. Such items as switch tenders (69), signalmen, crossing flagmen, drawbridge operation (90-92), and repairs of telegraph line (94) are entirely independent of the traffic.

The Enginehouse expense for yard (72) and road engines (81) are not directly proportional to traffic as a considerable part of the organization must be employed irrespective of volume of traffic, say 25%.

Tabulating this data, for the purpose of obtaining the proportion of fixed expense, we have:

No.	Item	Percentage not Affected by Traffic	Percentage of Total Operating Expense	Percentage of Total Operating expense not Affected by Traffic
61	Supt. of Transportation	75%	1.256%	0.942
62	Dispatching trains.....	75	0.845	0.634
63	Station Employees.....	75	6.886	5.165
65	Coal & Ore Docks....	75	0.176	0.132
66	Station Supplies and Expenses	75	0.574	0.431
69	Yard Switch & Signal Tenders	100	0.213	0.213
72	Enginehouse Expenses (yard)	25	0.524	0.131
81	Enginehouse Expenses (road)	25	1,729	0.432
89	Train Supplies & Expenses	25	1.843	0.461
90	Signal Operation......	100	0.532	0.532
91	Crossing Flagmen & Gatemen	100	0.360	0.360
92	Drawbridge Operation.	100	0.049	0.049
94	Telegraph & Telephone (line repairs).......	100	0.296	0.296
97	Stationery & Printing..	50	0.425	0.212

Percentage of Total Operating Expense not affected by the Volume of Traffic. 9.990

Dividing this 9.990 by 50.192 the total for all transportation expense, we have 20% of the transportation expense which is independent of the volume of traffic moved and 80% which is dependent on the traffic.

Traffic Expense and General Expense are not appreciably affected by the addition of a very consid-

erable volume of traffic and we may therefore assume all of these expenses to be fixed expenses.

Total Operating Expenses

Recapitulating the foregoing data, we may now tabulate to show what part of total operating expense is fixed and what part is dependent on the volume of traffic moved.

Class of Expenditure	Percentage of Total Operating Expense Affected by Volume of Traffic.	Percentage of Total Operating Expense not Affected by Volume of Traffic.	Percentage of Total Operating Expense.
Maintenance of Way.......	6.513	12.353	18.866
Maintenance of Equipment..	19.287	5.024	24.311
Traffic	None	2.914	2.914
Transportation	40.202	9.990	50.192
General	None	3.717	3.717
Fixed Operating Expense.	66.002	33.998	100.000

This table shows that 34% of all operating expense is a fixed expense, and is incurred whether the volume of traffic is very light or very heavy.

These figures apply to very considerable differences in volume of traffic. In the case of slight additions in volume of traffic, as a part of a car or the adding of one or even several cars to the average local freight train, the additional expense of operation on account of additional traffic is hardly appreciable.

Analysis Sufficiently Accurate for Practical Purposes

It may be objected to this form of analysis, that it is not scientifically accurate, in that it involves a division of certain items of expense on an arbitrary basis—on such items as superintendence, salaries of station agents, effect of different classes of trains on

maintenance expense and other items of a like nature.

It is true that there is room for some difference of opinion as to the percentages to be assigned to these various items of expense, particularly when average statistics for the whole country are used as a basis of analysis. Making due allowance for the personal equation, however, there is not room for serious variation in results obtained by various estimators.

The foregoing analysis is made for the purpose of establishing the **probable minimum** percentage of total expense which is a fixed expense and if that be established, with reasonable accuracy, it will assist in the consideration of many rate questions which are not otherwise readily understood. In the establishment of the minimum rate that is allowable, the fixed operating expense must be known approximately, to avoid making rates below actual cost of service. An illustration showing the necessity for and the application of this data is given in following pages.

Effect of Traffic Density on Operating Expense

If our deduction in regard to the fixed expense is correct, then the operating expense, **per unit of traffic,** must be less as the volume of traffic increases, because out of every dollar spent 34 cents is fixed, whether the volume is one million traffic units per mile of line or six million units, although the actual amount of money spent **per mile of line** for operating expense in maintaining the road and equipment and conducting transportation will be very much greater on the road of great traffic density.

To test the accuracy of these deductions, the following table was prepared from the operating statistics of the Interstate Commerce Commission for

the year 1913. The roads shown in the table were selected on the basis of difference in traffic densities to show the application of the principle.

The traffic density of the Illinois Central is very near the average for all Class I roads in the United States. The Pennsylvania has the largest revenue from traffic per mile of line and the greatest traffic density of any large system in the country. The Manistee & North-Eastern is a short road in Michigan, operating 190 miles of line with least traffic density.

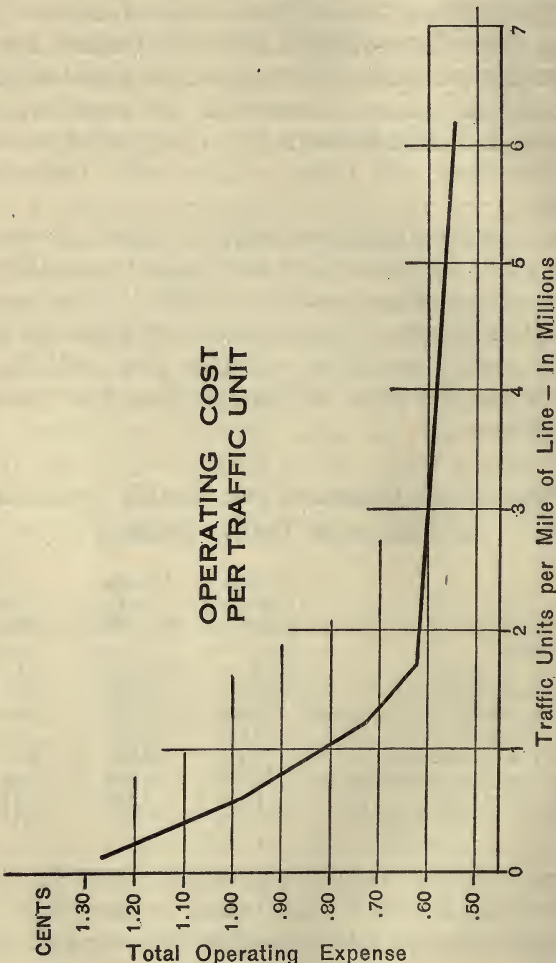
The "Traffic Units per Mile of Line" in the following table is the sum of the freight ton-miles and the passenger-miles per mile of line. The expense per Unit of Traffic is the quotient obtained by dividing the total operating expense per mile by the Traffic Units per mile, which affords a fair means of comparison.

Total Operating Expenses Per Traffic Unit—Roads of Different Traffic Density

Railroad	Total Operating Expense Per Mile of Line.	Traffic Units Per Mile of Line, Thousands.	Total Operating Expense Per Unit of Traffic.
Pennsylvania Railroad	$33,800	6,160	.549 Cents
Central Railroad of New Jersey	24,700	4,228	.584 "
Illinois Central	10,690	1,710	.625 "
Louisville & Nashville	9,150	1,260	.726 "
Atchison, Topeka & Santa Fe	7,770	904	.859 "
Atlantic Coast Line	5,350	528	1.013 "
Manistee & North-Eastern	2,170	174	1.246 "

Comparing the roads of greatest and least traffic density the Pennsylvania spent practically 15½ times as much **per mile** for operating expense as the Manistee & North-Eastern, but the operating expense **per unit of traffic** on the Pennsylvania was only 44% of the expense on the Manistee & North-Eastern or less than one-half as much.

In order to see what the **rate** of decrease is with, increasing traffic density, we may construct a diagram by platting the figures of this table.



The diagram shows that the operating cost per unit of traffic **increases very rapidly** when the number of traffic units per mile of road falls below 1,-

750,000, which is the average density of all Class I roads in the United States.

The operating cost per unit of traffic **decreases very slowly** when the number of traffic units per mile exceeds 1,750,000.

An important connection between the facts shown on the diagram and practical rate-making is, that on branch and main lines of secondary importance, having a traffic density less than the average, the rates per ton and per passenger mile must be larger than on the roads having a greater traffic density than the average, if such lines are to earn net out of their revenues in the same ratio as lines of average or greater traffic density. This is a most important principle of rate construction.

Physical Factors Affecting Operating Expense

The actual operating expense per ton-mile varies widely with differing physical characteristics. This applies particularly to the condition of a road as to its controlling grades.

A Mikado engine with a tractive power of 49,000 pounds can haul a train of about 4,080 tons up a 0.3% grade. Deducting the weight of cars and engine, it can haul 2,585 tons of freight. The same engine will haul 572 tons of freight up a 2% grade. The cost of operating either **train** is practically the same, but the cost of hauling **per ton,** on account of the grade, is about 4½ times greater on the stiff 2% than on the 0.3% grade.

The cost of operating over curved track is much greater than on straight track, due principally to increased cost of repairs of equipment. For each degree of curvature it is usual among engineers to estimate that the annual operating expense is increased 95 cents per train.

It is not unusual in a rough country to find 50 degrees of curvature per mile of line and in moun-

tainous country, two or three times as much. The increase in operating expense, annually per mile, on a line operating 30 trains, with 50 degrees of curvature per mile over that of straight line operation is 95 cents by 50 degrees by 30 trains, or $1,425.

Often freight rates in one locality are compared with rates in another on a ton-mile basis. Unless the physical factors of the two different operations are stated, such comparisons are absolutely worthless and misleading. One operation may be conducted on a railroad located in a flat plains country over straight tracks and very light grades; the other, on a railroad located over a range of mountains with a very tortuous line and the stiffest of mountain grades.

A comparison of the operating features of two typical lines, in connection with the statistics of actual operation, will serve to illustrate the effect of the physical factors on operating expense.

Operating Expense—Denver & Rio Grande v. Virginian

The Denver & Rio Grande Railroad extends from Denver, Colorado, to Ogden, Utah, with numerous branches, some of which reach into northern New Mexico. For practically all of its length it is built through the Rocky Mountains, the rough topography of the country necessitating much curvature and stiff mountain grades.

The Virginian Railway extends from the seaboard at Norfolk, Virginia, through the coal fields of West Virginia, to within a few miles of Charleston, West Virginia. While for much of the distance it is located in the Allegheny Mountains, it has easy curves and very light grades. Its principal traffic is the hauling of coal from the West Virginia fields to tidewater, its traffic in the opposite direction being quite small, comparatively.

In consequence the grades "favor the traffic," that is, the haul, generally, is a "down-hill" haul from the mountains to tide-water. The traffic is comparatively dense—the freight ton-miles per mile of line being 3,174,000—which, in connection with the advantage of light grades and easy curves makes the operating condition particularly favorable from an economic standpoint.

The following statistics from the Interstate Commerce Commission Reports of 1913, show the effect of these differing physical characteristics on operating expenses and net earnings. The figures are confined to freight traffic except as to the first and last items:

Items.	Denver & Rio Grande.	Virginian.
Operating Expenses per train-mile........	$2.067	$1.965
Average tons per train..................	305	1,330
Revenue per ton-mile.....................	1.04 cts	0.34 cts
Revenue per train-mile..................	$2.87	$3.409
Average Operating Cost per Traffic Unit..	0.96 cts	0.21 cts

The effect of the favorable grade condition is at once apparent from the first two items of the table. The Virginian hauls 4.3 times as much freight in its average train, and at an expense of 10 cents per train-mile less. In spite of the fact that the Denver & Rio Grande receives a revenue per ton-mile three times that of the other road, its revenue per train-mile is about 15% less. Taking both freight and passenger traffic into account the operating expense per traffic unit on the Denver & Rio Grande is 4.6 times greater than on the Virginian.

This comparison is between two roads, one of which has particularly unfavorable operating conditions and the other very favorable conditions, and they were selected for comparison for that reason. The same differences apply in varying degree quite

generally, however, in two broad divisions of all railroads, viz., the main trunk lines carrying a very heavy traffic and the branch and less important main lines which "feed" them.

The increased density of traffic has made it economical to reconstruct these main arteries of traffic, reducing the controlling grades and improving the operating conditions generally, as described in detail in the chapter on "Construction and Re-Construction." In consequence, their operating expenses are relatively very low, not only on account of dense traffic but are still further lowered by the favorable physical characteristics of curvature and grades.

Neither of these favorable conditions apply generally to other than these main trunk lines, and this fact should always be borne in mind in considering rates applying over main lines of minor importance and branch lines. What would be a fair rate, giving a return ample to cover all charges and expenses if applied to a busy main line, might well be ill-advised or even confiscatory if applied to a line of lighter traffic density and unfavorable operating conditions as to grade and curvature.

Terminal Expense

The cost of transportation is not directly proportional to distance for several reasons. The cost of the service involves two factors, viz., the cost of hauling from point of origin to destination and the cost of handling at both points.

When either of the terminal points is a large commercial or industrial center, these terminal charges (cost of handling) are a very considerable percentage of the whole cost, not only on account of labor involved in the handling of freight, but of the interest charges on the huge sums of money invested in terminal facilities. At Chicago and New York,

these terminal charges are generally considered to be three cents per 100 pounds, or sixty cents per ton.

On a shipment of sixth-class freight between these two points, the charge is at the rate of 26.3 cents per 100 pounds. The terminal charges of 6 cents are almost 23% of the whole charge, and this, too, when the haul is estimated at 920 miles. On the average haul for the Central and Eastern States, which is very much shorter, the terminal cost is a very much larger percentage of the total cost.

Satistics* in regard to the operation of 30 freight-houses showed a value of property employed of $12,000,000, and an average station expense of $166,000 per month.

Allowing for interest and depreciation on the value of the property employed, the total cost per ton for handling the freight was:

	Cents.
Interest and Depreciation......	28.6
Station Force and Shifting Cars.	41.5
Cost per Ton.............	70.1

The costs varied from 44 cents per ton for a Baltimore freight house to 98 cents per ton for one in Chicago. This cost is simply for the handling of the freight at the freight house and does not include such items of overhead expense as general supervision and other general expense.

These terminal expenses on that class of traffic which must be handled through freight houses are higher than on carload traffic handled on team tracks, and the carload traffic handled directly on the industrial tracks costs less than that on team tracks. These differences in terminal expense are

*From "Economics of Railway Operation," by M. L. Byers, C. E.

reflected in the rates charged for various classes of service.

It is not possible to make a comparison from the Interstate Commerce Commission statistics of various roads having different length of average haul, for the purpose of determining the net effect of distance on operating expense, as the cost of operation varies with the character of traffic moved, as well as with the distance, and there are other difficulties in the way of making satisfactory comparisons.

Apportionment of Expense Between Various Classes of Traffic

It is not possible to divide operating expense between different items of traffic accurately. It is not possible to make a division even into the two broad classes of freight and passenger traffic on all items of expense, except on an arbitrary basis.

An examination of the 117 items into which operating expense is divided by the Interstate Commerce Commission classification as given in a preceding table will show that this is true.

In the expense of maintaining the track (items 2 to 6), it is known that a passenger train increases the expense of maintenance more, per ton of train, than a freight train. The American Railway Engineers' Association estimates that a passenger car increases cost of maintenance per ton of car twice as much as per ton of freight car; a freight engine twice as much per ton as per ton of freight car; and a passenger engine four times as much per ton as per ton of freight car. This is probably as near the truth as it is possible to get.

As to some other items of Maintenance of Way expense the division must be made on an arbitrary basis, such as the respective earnings or train mileage of the freight and passenger traffic.

As to most items of Maintenance of Equipment, a division between passenger and freight equipment expenses can be made, and as to Transportation expense, most of the items of expense can be divided between passenger and freight service. There are many items, however, that can only be divided by making arbitrary assumptions.

It is evident that it costs a railroad more to handle and haul a ton of silk hats or millinery than it does a ton of coal, but when we come to investigate **exactly how much** more we find ourselves unable to do so because a division of the 117 items of expense cannot be made. Some operating expenses are affected by the hats that are not affected by the coal, and vice versa. The same is true of all items of traffic.**

One reason why rates for various items of traffic cannot be made strictly on the basis of cost of service is, that an accurate apportionment of expenses among the various items of traffic is not possible, and, therefore, the respective costs cannot be definitely determined.

Many complications would be encountered in applying strictly a cost of service basis to rates. Rates must be fixed **in advance** of performing the service of transportation. We have seen from the foregoing discussion that the cost per unit of traffic varies widely with its volume. Therefore, it is only **after** rates are in effect that the cost of service may be known.

If the rate has been fixed at $1 per ton on the assumption that 1,000 tons are to move, and only

While it is not possible to obtain the cost with exactitude, for each **item of traffic, it is possible to approximate closely the relative costs of broad divisions or classes of the traffic as, Products of Mines, of Animals, of Forests, etc., by a proper analysis of the operating statistics of **particular divisions** of a railroad, when these are available. This is discussed more fully in the following pages of this chapter, under the head of Importance of Cost Data.

100 tons move, the rate will be insufficient to cover cost; if 10,000 tons move, the cost will be materially less and the rate too high.

Cost of Service Principles

On the basis of these facts we may summarize as follows:

(1) That Capital Charges **per unit of traffic** decrease very rapidly as traffic increases. Up to the point where the capacity of the facilities are reached, capital charges do not increase at all with an increase in volume of traffic.

(2) It is a fair statement, as to average conditions, that at least 34% of Total Operating Expense is a **fixed expense** which will be incurred irrespective of the volume of traffic.

(3) On account of the fixed operating expense, the operating cost per **unit of traffic** decreases as traffic density increases. Such unit cost **increases very rapidly** as the traffic density falls below the average for the whole country; it **decreases slowly** as traffic density rises above the average. See diagram "Operating Cost per Traffic Unit," page 232.

(4) That as operating cost can not be accurately apportioned among different **items** of traffic, it is not possible to make rates which are based strictly on cost of service.

(5) That cost of service can not be known **in advance** of the actual transportation of any particular item of traffic, as such cost depends on the volume of traffic moved. It is only **after the rate has been made** that the volume of the traffic can be known.

Application of Principles

In some situations cost of service may mean either one of two possible costs, viz., (1) A cost

which includes a full proportion of the fixed interest charges and total operating expense; (2) or the **additional** cost which the transportation would add to existing total operating expense.

Suppose a road which had not previously carried a certain class of traffic were called upon to make a rate for performing such a service. Must it charge a rate made up of a percentage of fixed charges and operating expenses apportioned on the relation which the proposed tonnage bears to the total tonnage carried, or, inasmuch as fixed charges on capital and 34% of operating expense remain the same whether the service is performed or not, is the cost to be taken as the **additional** cost of performing the service?

Let us take for illustration an actual case where the proposed addition of traffic was large and constituted an important part of the traffic of the road.

The Cairo division of the C. C. C. & St. L. Ry. traverses the coal fields of Southern Illinois. Prior to the reconstruction of its line and the construction of the Chicago, Indiana & Southern (which is under the same control) from Danville to Chicago, it hauled no coal from these fields into Chicago. After the construction work had been completed, it entered the coal carrying business into Chicago. The tonnage of this coal business is very large in the aggregate—being measured by trains.

The distance from the Harrisburg mines to Chicago is 320 miles; on the reconstructed lines the grades are light,** which permits the hauling of long trains economically.

The established rate on coal by other lines between the same coal fields and Chicago was $1 per ton, which with the distance of 320 miles gave a revenue of 0.312 cents per ton-mile. The average

**Ratio of vertical rise to horizontal distance small.

revenue for the whole C. C. C. & St. L. Railway System was 0.543 cents per ton-mile, in 1914.

The average cost per ton-mile of freight (estimated by assuming that the total operating expense should be divided on the basis of freight and passenger earnings) was 0.394 cents per ton-mile. Apportioning the fixed charge—interest and rentals—on the same basis, gave 0.093 cents per ton-mile for this item. The total cost then was 0.394 cents operating expense plus 0.093 cents fixed charge, which equaled 0.487 cent per ton-mile.

That is, if the full proportion of fixed interest charge and of total operating expense were charged against the traffic, on the basis of tonnage, the cost of performing the service would exceed the revenue by:

Cost	0.487 cents
Revenue	0.312 cents
Loss	0.175 cents

On the 320-mile haul there would be, on this basis of estimating, a loss of 56 cents on every ton hauled.

But this method of estimating cost does not take into account two important related facts, viz., the 0.093 cents per ton-mile for fixed interest and rental charges and 34% of the total operating expense—the Fixed Operating Expense—had to be paid whether the coal was carried or not.

If only the **additional** cost of hauling the coal was considered, the cost per ton-mile was 0.260 cents—that is 66% of the total operating expense, which was 0.394 cents per ton-mile. On this basis, there was a profit** of 16.64 cents per ton of coal hauled, thus:

This illustration is used **only for the purpose of showing two possible methods of estimating cost. It must not be regarded as

Revenue per ton-mile........	0.312 cents
Actual additional cost.......	0.260 cents
Profit per ton-mile..........	0.052 cents

0.052 cents profit per ton-mile x 320 miles=16.64 cents per ton profit.

Equal Mileage Rates

Equal mileage rates, if applied to **all commodities alike,** would have no relation whatever to cost of service. Each item of traffic has its own cost, resulting from the conditions attending its transportation. When all factors entering into the cost are taken into account, it costs more to move a ton of fresh meat 1,000 miles than it does to move a ton of salt—as usually shipped—the same distance.

For **any given commodity,** equal rates for equal distances in all cases would not be based on cost of service. That is, it may cost more to haul a ton of lumber 100 miles on one road, or under certain commercial conditions, than it does to haul a ton of lumber 100 miles on another road, or under other commercial conditions.

There are two objections to a system of rates based on equal rates for equal mileages for a given commodity, viz; Physical and Commercial. To illustrate the Physical:

The statistics of the relative operating cost on the Virginian Railway and the Denver & Rio Grande, heretofore given, show that the average cost of transportation per unit of traffic is 4.6 times

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showing the actual cost of hauling coal. What the illustration indicates is, that if the operating cost of moving the coal per ton-mile is the same as the average cost per ton-mile for moving all commodities, the actual **out-of-pocket-expense** incurred in moving it is not greater than that shown. The interest on the cost and depreciation of the additional equipment, which would be required for such a large addition to traffic as that assumed, would of course have to be deducted from the net profit shown.

greater on the one than the other. Equal mileage rates applied to those two roads would evidently bear no relation to cost of service.

These differences in practical operating conditions are not confined to comparisons between lines located in greater part in a coastal plain and lines in mountainous regions. They exist very generally in all parts of the country.

The Paducah Division of the Illinois Central Railroad crosses the Ozark Hills in Southern Illinois. Its grades are steep and the traffic of the line is light, consisting principally of ties, piles, poles, and some coal. Its maximum train consists of twelve loaded cars with a total lading of about 300 tons or less. At the steepest grade on the line the train is broken up, only six cars being taken over this grade at one time, the engine returning for the remaining six cars.

The Virginian Railway operating between the West Virginia coal fields and the Atlantic ports carries an **average** of 1,330 tons per train. Evidently equal mileage rates, that is, the same rates per ton per mile for hauling coal on the two roads, would not be equitable.

The generally accepted view that certain rates for transporting any given commodity on one line as compared with rates on the same commodity carried over other lines, where the mileage is the same and the rates higher are in consequence unfair, fails to take into account the wide differences in the physical characteristics of two roads, particularly as to grades.

As to the commercial feature, statistics heretofore shown, and the discussion following them, clearly indicate that fixed charges and fixed expenses are distributed over a greater volume of traffic on busy trunk lines than on branch or main lines of secondary importance. To base the rate on the mileage, using

the same figure per ton-mile when hauled over a line of light traffic, where the cost per unit of traffic is high, as when hauled over a line of maximum traffic density, where the cost per unit of traffic is low, would place the rates on anything but a cost of service basis.

The Chicago, Burlington & Quincy Railroad between Alliance, Nebr., and Sheridan, Wyo., 330 miles, traverses a barren country very thinly settled, with no cities and no industry of importance on its line; between Chicago and Charlton, Iowa, 334 miles, its line is crowded with trains, as it passes through a rich agricultural and manufacturing district, producing much traffic and in addition carries a very large through business to points beyond in both directions. Evidently if the rate for hauling a ton of merchandise from Charlton to Chicago were applied to a ton of merchandise hauled from Alliance to Sheridan it would not be on a cost of service basis although the distances are practically the same.

It is hardly necessary to state that rates on a wholesale business may with justice be lower per unit of traffic than on retail business, as the cost of doing business is less. The principle finds universal application in the commercial world. The purchaser who buys coal by the car pays less per pound than the one who buys by the bag; the lawyer pays more for his paper bought by the ream than the printer who buys by the ton, although both the coal and the paper are of identical character in each case.

Finally, rates much lower than normal rates may be exceptionally profitable on particular commodities (as shown by the example of the Cleveland, Cincinnati, Chicago & St. Louis) without doing injustice to other commodities paying normal rates.

Speaking generally, rates must be based on the mileage, and they are so based usually. However, an

examination of rate tariffs shows in some instances that on the same articles for the same distance, over the same rails, the rates compared with each other are as 7 mills per ton-mile is to 10 mills per ton-mile. Taken in connection with the statement that generally speaking rates are based on mileage, such rates need explanation and the basis on which they have actually been fixed must be studied more closely.

The present rate structure is the result of economical development and commercial progress; an adapting of rates to changing business conditions and to competition with other forms of transportation; an adjustment between commodities and communities, between wholesale and retail business, between long hauls and short hauls.

It could not have been constructed at the beginning of the railroad era. To understand it, a study of its historical development is necessary.

Historical Development of Rates

English

The first railways were built in England to carry coal and other mine products; these carried neither merchandise nor passengers. The first passenger line was opened for traffic in 1830 and although promoted to carry freight, the passenger crowded the freight traffic from the line for some years.

In 1842, after other lines had been constructed, the average earnings consisted of 75% from passenger and 25% from freight traffic; on the main trunk lines only 15% of the total was derived from freight traffic. In the early fifties the earnings were divided 51% freight, 43% passenger and 6% from other sources.

The first passenger traffic represented customers taken from the stage coaches. They paid railroad fares averaging 4 cents per mile, first class; in the

beginning, the third class passenger traffic was insignificant. The number of passengers carried in 1842 was eighteen million. In 1902, the passengers carried were one and one-half billion, at an average fare of 1 cent per mile—one-fourth of the original fare. Nearly 90% traveled third class and about one hundred and eighty million traveled first class.

The first class traffic had therefore increased to ten times the volume of the 1842 traffic, but the **rate had remained practically the same**; the low third class fares had developed a traffic which did not exist at all during the early days of operation.

In view of the greater economy, convenience, safety and speed of railroad travel, it was inevitable that all of the then existing passenger business should come at once to the railroads. As canals and coasting vessels were available for cheap transportation, freight traffic was a different proposition. Further, the first locomotives were small and inefficient, the expenses large for operating them and the tracks of the railroad were fully employed by the passenger traffic. Under these conditions there was no motive for attempting to attract freight traffic from the cheaper existing facilities of transportation.

As the number of lines increased, competition between the various companies necessitated the construction of branch and other lines to occupy the territory tributary to their main lines. Such lines necessarily had less traffic density than the main lines and the new capital needed new business over which to spread increased capital charges.

To attract the existing traffic from canals, sea vessels and other routes and that class of traffic that could not otherwise move at all, the rates on freight traffic were reduced.

The freight traffic of these railroads began with a small volume of high class traffic carried at high

rates and was taken principally from the stage lines. The constant tendency has been to increase the volume of traffic by lower rates, taking lower classes of traffic successively.

The increase in volume has come from previously existing systems of transportation—as turnpike, canal and the sea—and from newly created traffic which the railroad itself has made possible. As the traffic increased, the rates have come down and the lower rates have in turn operated to further increase the traffic. The process has been continued to the point where the railroads have got all the traffic they can afford to take—that is, when the cost of handling the lowest class of traffic is but little less than the earnings from it.*

Development of American Rates

The experience of the English roads has been repeated in the United States and the development has been generally along the same lines. The freight traffic is much the more important part of the whole traffic in the United States, while it is of practically equal importance on English railroads.

In 1826 Josiah Quincy, as related in his diary, traveled from Boston to Washington by stage, the trip requiring eight days.

In 1832, at the beginning of the era of railroad construction, the stage coaches made the trip from New York to Boston, 195 miles, with no stops for rest, in 41 hours and charged a fare of $11.00. The trip could be made by steamer from New York to Providence in 1822 in 23 hours and thence by stage to Boston, 44 miles, in 5 hours, the fare for the stage

*The historical facts contained in the foregoing recital of English railroad development are based on information taken from "The Elements of Railway Economics," by W. M. Acworth, Clarendon Press, Oxford, 1905.

journey being $3.00. There were as many as twenty-five stage coaches running daily between these two latter points.

In 1836 the stage journey between New York and Philadelphia, 92 miles, consumed 14 hours and the fare was $6.00. In 1831 the stage journey between Philadelphia and Pittsburgh (348 miles by rail), could be made by the fastest mail stages in two and one-half days, by the ordinary passenger stages in four days. In 1837 the stage journey between Pittsburgh and Erie, Pa., stage distance 128 miles, required 46 hours without rest for sleep.

In the earlier period, between 1820 and 1830, it required more than three weeks to travel from New York to St. Louis, six days from Cincinnati and four and one-half days from Louisville. During the war of 1812, when the Atlantic ports were blockaded by the British Navy, the cost of transporting goods from Boston to Charleston, S. C., by wagons, was 40 cents a pound or $800 per ton.**

It is hardly necessary to state that under the condition existing at the time, the new railroads, very soon after their opening, drew all of the traffic from the stage coaches and wagons with which they competed. The last of the stages disappeared in 1850 as a consequence of railroad competition.

Railroad Competition with Erie Canal

The competition of the railroads with the canals, the most efficient existing means of transportation when railroad construction began, is illustrated by the rate history of the New York Central Railroad and the Erie Canal, with which it competed for freight traffic between the Seaboard and the Great Lakes.

**These historical facts are taken from a paper by Mr. Seymour Dunbar, appearing in the "Railway Library" for 1914.

The Erie Canal, completed in 1825, connects the Hudson River with Lake Erie at Buffalo. The New York Central Railroad practically parallels the Hudson River and the Erie Canal for the whole distance. It was completed in 1842, though at that time it was owned by fourteen independent companies. In 1853, Vanderbilt bought up these independent companies, amalgamating their separate holdings into one system, whose length from New York to Buffalo was 438 miles.

Between 1825 and 1853, the canal rates were reduced so that the tolls in effect were only about one-third of the original charges. Even with this very radical reduction in rates, the canal paid the State of New York, which owned it, an annual profit of 50% on its original capital.

To draw the freight traffic from the canal, the railroad put in low rates. The traffic came with the lowered rate, and as the expenses and charges were spread over a greater volume of traffic, reduced the unit cost; rates were again reduced and traffic thereby further increased.

This reciprocal process went on until the canal traffic practically disappeared, although in the meantime the State had abolished all tolls and assumed all cost of maintenance of the canal to encourage canal traffic. The State is now expending more than one hundred million dollars in enlarging the canal, in the hope of restoring competition between rail and water carriers.

The railroad however is moving a traffic which is much greater than the old canal could have moved, and the average rate for moving it is less than 20% of the original rates.

The effect of these low rates on the grain states of the middle West has been enormous, in shortening the time required for their development.

Rates Reduced to Stimulate Traffic

It is to be noted, however, both as to English and American rates, that while the **average** rate has come down, by reason of the lower class of commodities which have been added to the volume of traffic from time to time, the rates on high class traffic have not decreased in proportion, and not at all in some instances. It is probable that rates on millinery, silks, clocks, imported cigars and like commodities are quite as high now as they ever were.

The reduction from original rates were made to stimulate traffic. A low rate on limestone, ore, sand or coal, or a low passenger fare, has been made on the principle that there will be a greater net profit on a large business done on a small margin, than on a small business done on a large margin, or of no business at all, as to some commodities.

There are some classes of traffic which are not stimulated by low rates; no amount of practicable reduction would increase their consumption, and in consequence, the amount of traffic to be moved on account of them.

A reduction in the rate on shoes from Boston to Kansas City would not cause one more pair of shoes to be sold there. The whole rate is an insignificant percentage of the retail value of the shoes. Low rates on packing house products from Kansas City to Boston, however, have enabled the packers to widen their markets, to sell more of their products, and hence to increase the volume of railroad traffic. The rates on such products, when moved long distances, are a considerable percentage of their selling price.

A reduction of 10 cents per ton in a coal rate will enable the miner to ship coal perhaps 30 miles further in every direction from his mine. His tributary area—market—will thereby be greatly in-

creased, and in consequence the volume of railroad traffic.

A railroad is justified in reducing the rates when the traffic will be stimulated thereby, but it is not when the reduction serves to reduce its revenue per unit of traffic, without any corresponding increase in the volume.

Reduction in the rates on high class traffic have only been made to meet competition. While the rate may be an insignificant portion of the value of the commodity, and the shipper able to pay a larger rate, he will pay no more than he must. If the rate from Boston to Seattle on iron and steel articles, when shipped by vessel through the Panama Canal is only 75% of that charged when shipped over a railroad, a large part of the business will go through the Canal. If the railroads move the traffic, their charge can only be the rate via the Canal plus whatever the additional safety, speed and regular service of the railroad is worth to the shipper.

Summary of Historical Development

The historical development of rates may be summarized by saying, that the highest rates now current were made in the early history of railroads and apply on traffic taken away from the stage coaches. That by repeated reductions in rates the railways have acquired traffic: (1) From undeveloped territories and from districts distant from their markets. The grain traffic from the undeveloped territories of the Middle West and Northwestern States to the Atlantic seaports, is an excellent example of this class of business.

(2) In commodities of lowest commercial value. The traffic in such commodities as coal, ore, limestone, sand and ice, is one created entirely by the railroads. Before the railroad era, coal was used

only at the shaft or in favorable situations where its transportation by water was possible.

(3) In competition with existing systems of transportation. The New York Central Railroad and Erie Canal is an illustration of this class of traffic.

The principles upon which this traffic has been acquired are:

(1) That the greater the volume of traffic, the less the cost per unit to transport it, therefore **reductions in rates which increase traffic are warranted.**

(2) That the rates for any class of traffic must not be so high as to stop it from moving, EXCEPT, that the rate shall never be so low that it does not cover the **additional** cost incurred in dealing with the particular traffic under consideration.

In regard to the first principle, a rate which would not be profitable on an existing volume of 1,000 tons of traffic might be very remunerative on 10,000 tons.

The second principle sets the limit for the highest and lowest rates. The maximum rate is fixed by the ability of the commodity to pay and the minimum by the actual out-of-pocket expense incurred in performing the transportation, plus the smallest of profits.

In the application of these principles to a schedule of rates, consideration must be given to the relation of the rates charged on articles competing with or which may be substituted for each other; that the rate per mile must decrease as the distance increases and that the rates per ton must decrease as the weight of shipment increases.

Rate-Making Not an Exact Science

To the most superficial observer, however, it is apparent from a reading of the historical development of rates or from a study of the principles upon which the rate structure has been based, that it is not pos-

sible to say that any particular rate is in itself reasonable—that is that 100 cents per ton is the **exact** amount that should be charged for hauling a ton 320 miles and prove that 99 cents or 101 cents is not as fair as the 100 cents charged.

Any rate is the resultant of many different causes and considerations; cost of service, value of service, competition between transportation systems, adjustment with rates on other articles with which it competes and many other things.

Establishing a schedule of railroad rates, like fixing rates of taxation, requires a method combining **both** art and science. The exact values to be attached to some factors having a most important bearing on rates, are not susceptible of definite mathematical analysis.

Importance of Cost Data

It must be remembered in connection with the foregoing, that while the **exact** cost of service can not be stated with scientific accuracy, it is entirely possible to do much better than merely **guess** at what the costs of carriage as to certain commodities actually are.

In estimating the cost of production of any plant, whether it be an industrial or a transportation plant, in which more than a single article is manufactured or over which more than one class of traffic is carried, it is necessary to make a division of that portion of total expenditure which applies to the operation of the plant as a whole and which can not be divided among the various articles produced or commodities carried, specifically—such items as interest on invested capital, overhead charges, superintendence and general expenses are the ones referred to.

In making a division of such expenses among the articles produced or transported, it is obvious that

some basis, which will be more or less arbitrary, must be used. While such a basis must of necessity be arbitrary and hence not susceptible of a strictly scientific analysis, it may still be substantially accurate and sufficient for practical purposes, if intelligently applied.

Analogy Between Railroads' and Packers' Cost

Transportation costs are not essentially different from those of most other lines of business in which more than one article of commerce is produced. The packer buys a steer at a certain price per pound on the hoof, but that is the only cost of his manufactured product that he may state with accuracy.

The products manufactured from the steer are, meats of various classification, hide for leather, horns and bones for buttons, hair, soap, fertilizer and numerous other commodities. The packer can not say exactly what part of the cost of the steer is to be apportioned to the meat and what part to the hide, bones or soap.

When he comes to place a selling price on the various commodities produced from the steer, however, he must apportion its cost among them all, if he is to know even approximately what it has cost him to produce the commodities which he sells.

The fact that his business, primarily, is that of producing meat, and that these other commodities are by-products, does not relieve him of this necessity for apportioning cost. Railroads were constructed, primarily, to carry passengers and high class freight which had been previously carried by stage coaches. The carrying of other commodities in the beginning was, in a way, a by-product of transportation, which has since become much the larger part of the business.

Engineers' Method of Analysis Applied to Traffic

Railroad engineers, charged with the maintenance of operated roads and the construction of new and reconstruction of old ones, have analyzed operating expenses for the purpose of ascertaining what effect such physical factors as distance, curvature and grades have on such expenses.

All that is claimed by them for their method of analysis is, that it shows that the effect of certain changes in the physical operating conditions of a road will reduce operating expense by an amount **not less than a certain stated minimum** and **not more than a certain stated maximum,** the actual reduction being **certainly** between the maximum and the minimum, however.

For all practical purposes this method of analysis works very well, and the values for the various physical factors mentioned are universally used in American railway practice, in determining the advisability of reconstructing older roads and in comparing the desirability of adopting any one of various possible lines in the construction of new roads. The decisions based on these analyses, involve the expenditure of millions of dollars annually.

The analyses of the engineers apply to the physical factors of operation and not to traffic. There is no good reason, however, why analysis of operating expense along the same general line should not be used to ascertain certain cost factors which apply to various classes of traffic. To develop such factors will require special study and analysis of operating expense statistics as at present classified and, in addition perhaps, the making of a further division or other classification of operating expense with particular reference to traffic conditions.

Relative Cost of Certain Commodities

Evidently the task of ascertaining cost factors, separately, for each commodity transported, is too large to be practicable, but those applying to certain general divisions of traffic as, Products of Mines; of Forests; of Animals; of Manufactures and Farms, or to particular commodities such as Grain, Coal and Live Stock, may be determined, within reasonable limits, without an unreasonable amount of labor or expense.

The relative costs of handling traffic through freight houses and on team and industrial tracks may certainly be studied further with profit.

Relative Cost on Main and Branch Lines

The relative cost of transportation on branch and secondary main lines, on the one hand, and on main lines of maximum traffic density, on the other, is one particular feature that certainly needs investigation. The low rates now charged for transportation service over lines carrying light traffic, must in many instances be below cost of service.

The fact that under present conditions short local lines can be profitably operated only under exceptionally favorable circumstances, warrants the suspicion that many such lines which are part of the larger systems are operated at a loss.

If this is true, it can be shown by a proper analysis of existing operating records—or the necessary statistics may be obtained—and on a proper presentation of them these confiscatory rates can be eliminated.

Operating Expense Not Heretofore Analyzed in Relation to Traffic

In this connection, attention is directed to the fact that operating expenses have heretofore been

classified and studied for the purpose of maintaining operating efficiency with the minimum possible expenditure. Meantime the rates charged for transportation have been radically reduced. In making such reductions, traffic officials have had no accurate data to guide them. It is conceivable that under these conditions, some rates may have been, unknowingly, reduced below the actual cost of performing the service for which the rate is charged—in fact is would be strange indeed if this had not happened in many instances.

Commercial, Legal and Economical Factors of Rates

Determination of the proper rate involves the consideration of three classes of factors, viz: Commercial, Legal and Economical.

The traffic official will consider the rate from a commercial point of view, adjusting it to the needs of the shippers.

The lawyer will investigate to determine whether or not the rate so established discriminates between various classes of shippers or between shippers in various localities.

Neither of them, however, have had any training or experience as a basis on which to form a judgment as to whether the rate is properly adjusted to cost of service, which is an economical problem whose solution would seem to belong properly to the engineer.

That is, there must be a Traffic Engineer, with practical operating experience and a general knowledge of traffic matters acting with the traffic official and the lawyer in order that the interest of the railroad be properly safeguarded.

The necessity for more accurate data as to absolute or relative cost of transportation is very apparent at hearings before the State and Interstate

Commerce Commissions when the fairness of a rate is being investigated.

The writer believes that while many of the Commissions exaggerate the importance of cost of service as compared with the value of service, the fact remains that under present conditions, the railroads' position at such hearings could in many cases be materially strengthened by cost data more reliable than has yet been developed.

Cost Data More Important in Near Future

The least consideration of existing conditions will show the necessity for the study and analysis of the relation of expense to traffic here suggested. The importance of the subject is likely to be increased, rather than diminished, by events which may be reasonably anticipated.

The whole industrial and commercial interest of the country is preparing for a largely increased export of manufactured and other products. It is inevitable that industries located at interior points and those located nearer the sea ports will soon be in keen competition with each other for a portion of this export trade.

The transportation charges on the raw material from the interior to industries near the coast, and on manufactured products from the interior to it, will often be a very large factor in this industrial competition. In consequence, much pressure will be brought to bear upon the carriers for reductions in rates on the export traffic and the margin of profit in transporting it will necessarily be narrow.

Without information, within reasonably definite limits, as to the actual or relative cost of transporting various classes of traffic, the carriers are in danger of either reducing their rates too much, in competition with each other for the traffic, or on the

other hand, not making concessions to some industries sufficient in amount to allow them to market their products at a profit and still leave a profit for the carrier.

That is to say, with the margin of profit very narrow, definite information as to actual or relative cost is absolutely essential in conducting the business economically, with profit and justice to the carrier and the shipper.

Nothing said in this discussion of the necessity for more accurate data as to cost of service, detracts from the force of the statement heretofore made, that rates cannot be based strictly on cost of service.

Cost of service is **only one of many** elements to be considered in making rates. **It is however a limiting factor in all rates,** from the fact that no rate can be justly made which does not cover the actual out-of-pocket expense incurred in performing the service for which the rate is charged.

Any rate which does not cover such expense is fundamentally wrong and unjust, in that the other items of traffic transported must bear a burden of cost not justly attaching to them if any portion of the traffic is carried at a loss.

Value of Service Basis**

This euphonious title is a substitute for the much abused "What the traffic will bear." To the general public it has heretofore meant a method of extortion, while it is in fact a principle of moderation. It is based on equality of sacrifice by those who pay the rates; on equitable concessions by the stronger to the weaker members of a community. Freight of high value and traffic near its market is made to average

**This article is suggested in large part by the discussion of the same subject in "Elements of Railway Economics," by W. M. Acworth.

up rates with bulky freight of low value and traffic distant from its market. Under this system there are three general classes of rates:

(1) Those which apply to traffic, which either through being bulky and of low value or which requires long hauls to bring it to market, is unable to bear high rates. The rates are just far enough above the actual **additional** expense incident to handling the traffic to furnish a small profit, no part of the interest and other fixed charges or fixed operating expense being included in the rate.

(2) Those applying to medium class traffic, the rates including actual expense and a proportionate part of fixed charges and fixed operating expense.

(3) Those applying to high class traffic—goods of large value—and to traffic near its market, the rates including actual expense and a larger part of fixed charges and fixed operating expense.

Justification of Value of Service Basis

What effect do such rates have on the interests of those most concerned—the railroad, the public and the shipper of high class traffic?

It will be noted that even on the lowest class of traffic there is still a profit to the railroad, however small it may be, and that **all** business contributes **something** toward the expenses of the railroad.

It is beneficial to the public, because traffic in many commodities that it needs is made possible which could not move if it were compelled to pay the actual expense and its full share of fixed charges and fixed expenses.

It is in the interest of the high class traffic, because any amount paid by the lowest class of traffic, in addition to the actual additional cost its movement involves, helps pay the general expenses of the rail-

road, which the high class traffic would otherwise have to pay unaided.

Argument of the First Interstate Commerce Commission

In the beginning of their investigation in 1887 the Interstate Commerce Commission was compelled to consider the question of whether rates based on what the traffic would bear—value of service—rather than on cost, were fair and equitable. The Chairman of the Commission at that time was the great constitutional lawyer, Judge Cooley. The conclusion of the Commission, as published in the first annual report, is expressed in the following:

"It was very early in the history of railroads perceived that, if these agencies of commerce (railroads) were to accomplish the greatest practicable good, the charges for the transportation of different articles of freight could not be apportioned among such articles by reference to the cost of transporting them severally; for this, if the apportionment of cost were possible, would restrict within very narrow limits the commerce in articles whose bulk or weight was large as compared with their value.

"On the system of apportioning the charges strictly to the cost, some kinds of commerce, which have been very useful to the country, and have tended greatly to bring its different sections into more intimate business and social relations, could never have grown to any considerable magnitude, and in some cases could not have existed at all, for the simple reason that the value at the place of delivery would not equal the purchase price with the transportation (cost) added.

"The traffic would thus be precluded, because the charge for carriage would be greater than it could bear. On the other hand, the rates for the carriage

of articles which within small bulk or weight concentrate great value would, on that system of rate-making be absurdly low when compared to the value of the articles, and perhaps not less so when the comparison was with the value of the service in transporting them.

"It was, therefore, seen not to be unjust to apportion the whole cost of service among all the articles transported upon a basis that should consider the relative value of the service more than the relative cost of carriage.

"Such method of apportionment would be best for the country, because it would enlarge commerce and extend communication; it would be best for the railroad, because it would build up a large business; and it would not be unjust to property owners, who would thus be made to pay in some proportion to benefit received.

"Such a system of rate-making would in principle approximate taxation; the value of the article carried being the most important element in determining what shall be paid upon it.

"To take each class of freight by itself, and measure the reasonableness of charges by reference to the cost of transporting that particular class, though it might seem abstractedly just, would neither be practicable for the carriers nor consistent with the public interest.

"The public interest is best served when the rates are so apportioned as to encourage the largest practicable exchange of products between different sections of our country and with foreign countries; and this can only be done by making value an important consideration, and by placing upon the higher classes of freight some share of the burden that on a relatively equal apportionment, if service alone were considered, would fall upon those of less value.

"With this method of arranging tariffs little fault is found, and perhaps none at all by persons who consider the subject from the standpoint of public interest."

Analogies in Commercial and Other Pursuits

As heretofore shown in the article on Importance of Cost Data, it is not always possible to say which part of the selling price of any commodity is cost and which part is profit. As it reaches the retail merchant however, it has for him a definite cost.

Merchants' Rates

Suppose a suit of clothes costs the retail merchant \$15. If he offered this at \$20 he would receive his cost and what would be considered a fair profit. But if he can sell for \$25 he will not sell for \$20, simply because the latter represents cost plus a profit at a certain per cent.

He will base his price on the value of the clothes to the purchaser, not on the cost to himself. If near the end of the season he finds himself over-stocked, he will reduce his price to say \$18 and while the profit is less, still it is a profit; if he can only sell at \$12, he will do so, on the principle that a small loss is better than a total one.

The groceryman sells common sugar, in a paper bag, at the narrowest margin of profit, and loaf sugar, in a box, at a much greater profit, although the latter sale costs him less to make than the former. He sells tomatoes, packed in cans, at a smaller profit than he does asparagus tips or imported French peas, packed in cans, but his cost of selling is the same in either case.

The tobacconist sells a five cent package of smoking tobacco at an infinitessimal profit, and an im-

ported cigar at a good round one, although his cost of service is the same.

The business of the clothier, groceryman and tobacconist is on a value of service basis, in the main —not on cost of service, except that the profits from all of their customers together, must furnish enough money to pay all of their business expenses and charges and a fair profit for their services. The apportionment of the expenses, charges and profits among their customers is made on the basis of their respective abilities to pay.

The clothier does no injustice to the man who pays $25 for his suit, when he sells the same kind of suits later at $18 or $12 to other customers. If he were unable to reduce his loss by selling for $12, or to make his smaller profit on the $18 sale, evidently all other customers must pay more for what they buy, because the business, as a whole, must pay all expenses, charges and profits and these latter sales at lower prices reduce the losses or increase the profit to some extent.

Professional Rates

A broker in selling securities, charges a percentage of the value of securities, not for the labor involved, for it is much the same whether one or a hundred shares are sold. If his customers all bought one share only he could not live.

A doctor charges on the basis of the ability of his patient to pay—one price to the poor man and a higher one to the wealthy, although the work and the skill are the same in both instances. The lawyer's fees are based largely on the values and the importance of the issue involved when he writes his opinion or defends his client.

All of these brokers and professional men base their charges on value, not on cost of service, and they seek to average their charges so that the return

from all of them will give an adequate remuneration to themselves and not bear heavily on any one class of their clients.

It is not unfair to the wealthy man that the doctor charges the poor man less, for if the doctor did not receive some part of his income from the poor man he must evidently collect more from the wealthy one to obtain an adequate income.

Rates Charged for Electric Current

The supplying of electric current is practically a monopoly under public control. The charges per unit for its use vary more widely than railroad rates.

In the earlier history of the business, lighting rates were fixed with reference to the rates charged for illuminating gas, so that the new industry might compete for the business of supplying light, which had been monopolized by the gas companies for a long period of time.

The rates for supplying electric current for power purposes were, and still are, made on such a basis as to induce the users of steam and gasoline power plants to substitute electrical current and appliances for them.

At the present time—1916—the lighting rates in Chicago are:

First 30 hours of maximum demand per month 10 cents per Kilo-watt-hour.

Next 30 hours of maximum demand per month, 5 cents per Kilo-watt-hour.

All in excess of above, 3 cents per Kilo-watt-hour.

The Commonwealth-Edison Company state, that the general average paid for lighting, in the city as a whole, is approximately 6 cents per kilo-watt-hour.

The rates for power current vary from 0.8 cents to 6 cents per kilo-watt-hour, depending on the amount of current used and the condition attending

its use. The current for the motor used for cleaning hats at the shoe-shining stand will usually cost about 6 cents per k-w-h; the current for the immense cement plant, which uses maximum power 24 hours per day, costs about 0.8 cents per k-w-h.

It will be noted that these rates are based on both the cost and the value of the service, the latter being the controlling factor, and that they are lower for wholesale than for retail use, although the cost of current production is the same.

Production of electric current involves large capital cost for machinery and transmission systems. The plant and force must be able to supply the maximum demand for current. This maximum demand for lighting lasts only for about three hours of the day; for the balance of the time the larger part of the plant is idle, with large fixed charges, operating expense and depreciation going on constantly.

If power consumers can be induced to use current by the lower price, the **additional cost** per unit to the company of producing the **additional current** is small, compared with the cost of producing a unit for lighting only, particularly as the use of current for power does not occur at the same time as the maximum load required for lighting. Even if the profit per unit on the power current is small, it helps pay the general expenses of the company.

This lower rate is not made possible at the expense of the user of light current at a higher rate, but in fact reduces his rate. The constant and substantial reductions in all rates which have actually been put in effect and which are next shown, prove the soundness of the reasoning.

The following statement shows the average prices paid for electric current for lighting purpose for various periods:

1896—1897	Per Kilo-Watt-Hour	19.5 cents
1898—1904	"	13.33 cents
1905	"	12.00 cents
1914	"	6.00 cents

This data shows that the cost of lighting to consumers has been reduced 69% in about 20 years, largely through the application of this principle of rate-making. In the last six years, it has also served to reduce the average cost to the users of power current by percentages varying from 36% to 43.7%.**

These reductions approximate those which have been made in railroad rates, between the inception of the railroad enterprises and the present, through the application of the same principle.

As in the other cases cited, the total receipts from all sources must pay all charges and expenses plus a profit, but the rates are based mainly on value of service and not on cost, for the cost of producing the current used for various purposes is the same and the rates vary with class of service.

Canal and Turnpike Rates

The canal and turnpike tolls have always been based on ability to pay. Tolls are charges for the **use** of the canal or road and do not include the service of transportation over them.

It costs such companies no more to allow a ton of apples to be hauled than a ton of stone or any other commodity passing over or through their facilities, and yet they have always differentiated between commodities.

An old tariff of the Sheffield Canal in England provided for a rate of 4 cents per ton on turnips and potatoes and 8 cents on onions, apples, peas and

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**Data in regard to rates furnished by the Commonwealth-Edison Co. of Chicago.

beans; for pig iron 6 cents per ton and for bar, rod or rolled iron 8 cents; for "green groceries" 8 cents per ton and for "dry groceries and all kinds of manufactured goods" 10 cents.

Rates of Taxation

The foregoing are analogies with methods used in commercial lines of business. The community as a whole, acting in its corporate capacity, follows the same method in taxation. All taxation of real estate and improvements is based on the value of the property.

The owner of a building costing $20,000, built on a lot with a 50 foot frontage, gets no more service for his taxes than an owner of a building costing $3,000 built on a lot with the same street frontage.

The cost of policing, fire protection, street maintenance and all other work and things required, for which taxation is laid on the property, is the same in one case as in the other.

So too with the income tax of the Government and the inheritance tax of the State. The large income and the large inheritance are taxed at a higher rate than the moderate ones and the small ones are not taxed at all.

That is, taxes are based on equality of burden or sacrifice of the citizens. The laborer, clerk or mechanic, who has only a narrow margin between income and living expense is not asked to pay even a small portion of his small margin; the large income and the estate of the capitalist are well able to pay a differential rate over that of the moderately well-to-do merchant.

In all taxes laid on real estate, improvements, incomes, or inheritance, this principle of equality of burden or sacrifice is applied in fixing the rate.

Charging what the traffic will bear, or basing the rate on the value of the service to the user or on his ability to pay, is not peculiar, then, to railroads. It applies in all commercial lines, professional fees, the charges of other public service corporations and to rates of taxation—that is **it prevails in all business life and public service.**

Classification

The foregoing discussion shows that the traffic as a whole pays the expenses, fixed charges and profits as a whole; that each separate item of traffic pays such portion of that whole as it is able to pay.*

The apportionment between the different items can only be an approximate one at the best, but it seeks to distribute the burden equitably.

Boots and shoes, new, are first class; old worn-out shoes, third class in less than carload lots, and fifth class in carload lots. It evidently costs the railroad company as much to haul the same weight of **old** shoes packed in boxes as it does **new** shoes packed in boxes, but if it charged as much for the service little traffic would move.

It is also evident that old shoes shipped in cars, loaded by consignor and unloaded by consignee and forwarded under one bill of lading, will cost the railroad company less per 100 lbs. than a few boxes of old shoes weighing several hundred pounds, forwarded by various consignors and hence billed separately and loaded and unloaded at the cost of the railroad.

The third class rate on old shoes as referred to the first class rate on new shoes is based on value of service; the fifth class rate on carload lots of old shoes

*In this connection, it must be remembered that the phrase "Can pay" or "ability" to pay is modified by "what the traffic will consent to pay" as illustrated in following pages.

as referred to the first class rate on less than carload lots of new shoes, is based on a combination of value of service and cost of service.

The ores of Gold, Silver, Copper and Lead, in sacks, boxes or barrels, when the value exceeds one dollar per pound are classified at double first class; when value does not exceed 40 cents per pound, first class; when value is between 5 and 40 cents per pound, second class; when 5 cents or less, third class. Iron ore, similarly packed is classified fourth class.

These classifications are based on the value of the commodity and the increased liability of the railroad in case of loss in transportation or by theft.

Paint, in glass or earthenware, packed in barrels, is classified first class; in pails or metal cans packed in barrels, third class; in bulk, in barrels, fourth class. These classifications are based on value of commodity and the liability of the railroad to loss on account of breakage in transportation.

Stove Ovens, knocked down, flat and crated, are classified third class; when not knocked down, but crated, first class. These classifications are based on the difference of space required in the car per unit of weight, on account of the manner of packing, which affects the cost of service of the railroad.

To summarize this, Classification, is based in some cases on value of service, in others on cost of service, in still others by a combination of the two. The value of the commodity, the liability to loss through theft or breakage in transportation or handling, and the ratio between space occupied and weight, are all factors entering into classification and hence in the charge made for performing the transportation service.

Methods of Rate-Making

Many of the states have established through their commissions what are known as a mileage scale of

railroad rates and in some cases independent classifications as well. As different classifications are applicable in different states, comparisons between the rate schedules as a whole can not be made usually, but must be confined to individual commodities. There are certain general principles however underlying the construction of all of these scales.

The following table shows the rates for distances, 10 to 500 miles, and the rate per ton-mile as well, on first class merchandise and on carload shipments, as provided in the mileage distance scale established by the Illinois Commission.

Illinois Mileage Distance Scale **

Distance in Miles.	Merchandise, 1st Class, Rates per ton.	Merchandise, 1st Class, Rates per ton-mile.	Carloads, 6th Class, Rates per ton.	Carloads, 6th Class, Rates per ton-mile.
10	$2.40	24 cents	$1.02	10.2 cents
100	6.16	6 "	2.34	2.3 "
200	7.82	3.9 "	3.04	1.5 "
300	8.88	3.0 "	3.40	1.13 "
400	9.62	2.4 "	3.82	0.95 "
500	10.00	2.0 "	4.10	0.82 "

**The entire scale is not shown; only enough, and in such form as will illustrate the principles of rate-making involved in its construction.

The rates per ton increase with the distance, but not nearly as fast. Comparing the rates in the second column (Merchandise, 1st class) for 10 and 400 miles, it will be seen that while the distance is 40 times as great, the rate is just 4 times—that is the rate has increased only one-tenth as fast as the distance, so that the **rate per ton-mile** is only one-tenth as much at the greater as at the smaller distance.

Comparing the rates for 10 and 500 miles in the fourth column (6th class, carload shipments), it will be seen that while the distance is 50 times as great, the rate is just 4 times—the rate has increased only one-twelfth as fast as the distance, so that the

rate per ton-mile is only one-twelfth as much at the greater as at the smaller distance.

While these exact ratios of distance to rate do not exist as to all Mileage Scales, the same principle is used in constructing all State and Railroad Association scales.

The explanation for the decrease in the rate per ton mile as distance increases is found in the following facts:

(1) The terminal charges are included in the rate, and are the same regardless of the distance. This explains the large decrease in cost per ton-mile between 10 and 100 miles. On short hauls the terminal charge is a large proportion of the whole rate; in the case of a 10 mile haul perhaps 50% of it*, on a 100 mile haul 20%, on 500 mile haul, 12%.

(2) The greater the distance hauled, the less per ton-mile cost to haul it. That is 10 tons hauled 20 miles, making 200 ton miles, costs more than 1 ton hauled 200 miles, although the total ton-miles are the same in each case.

The reasons, broadly, are that long hauls get more mileage out of engines, cars and train crews; the engines and cars are more nearly loaded to capacity; the line more continuously utilized and the delays occasioned by loading and unloading at short intervals are avoided.**

(3) Traffic becomes less able to bear the rate as distance increases, as it (the rate) becomes a larger proportion of the value of the commodity transported. In the case of coal, limestone, sand and such commodities, this factor applies at comparatively short distances as the rate is a large portion of the selling price; in the case of Boots and Shoes

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*On basis of 3 cents per hundred, or 60 cents per ton, at each terminal.

**This is another way of saying that "through" freight costs less to transport than "local" freight.

or Millinery, it scarcely limits the distance of shipment at all, the percentage that the rate charged per ton bears to the value per ton of Shoes or Millinery being small even for the longest distances.

Percentage and Differential Method of Rate Construction

More than 50% of the total railroad traffic of the United States is moved within an area known as Central Freight Association, Trunk Line and New Eng-

land territories. The small accompanying map** indicates in a general way, the boundaries of these traffic territories.

**The map shows the territories between which the rates apply. The boundary of Central Freight Association territory in north-western Illinois, is not exactly as shown on the map, the rates applying to points west of the western boundary of this Association's territory. This has no significance so far as this discussion is concerned, the term Central Freight Association as used herein being intended to cover the territory as indicated on the map.

The rates applying **between** Central Freight Association territory, on the one hand, and Trunk Line —New England territories, on the other, are made by what may be termed the Percentage and Differential Method of rate-making, which is next described. (This discussion **does not** refer to rates between two points, **both** of which are in Central Freight or **both** of which are in the Eastern territories, but to rates between two points, one of which is in Central Freight and the other in the Eastern territories.)

Base Rate

The rates from Chicago to New York are the base or unit rates and are termed 100 per cent rates. The rates between all points in the Central States and the City of New York are some percentage of this rate, varying from 60% to 120%.

At the time the method was adopted, the Chicago-New York rates were:

100 PER CENT RATES

Classes	1	2	3	4	5	6
Rates in Cents per 100 lbs	75	65	50	35	30	25

Percentage Groups

The distance from Chicago to New York was taken at 920 miles and the terminal charges as 3 cents at each of the termini or a total of 6 cents. A deduction of 6 cents for terminal charges was first made from the 6th class rate of 25 cents, leaving 19 cents as the amount allowed for **hauling** a disance of 920 miles or at the rate of 0.0206 cents per mile per 100 lbs.**

For other points in the territory, the rates were fixed at a percentage of the rate from Chicago to

**Rate per ton-mile 4.12 mills.

New York, the points taking rates higher or lower as they were more or less distant* from New York, than was Chicago. The factor of 0.0206 cents multiplied by its distance from New York, plus 6 cents for terminal charges, established the rate for any point. The percentage which the rate so established bore to the base rate of 25 cents, determined the percentage of the Chicago-New York rates which the particular point would take.

When first put into effect, these rates applied only to competitive and junction points, the rates to points intermediate being made by adding the rate from the nearest junction to the through rate of the junction point. Finally these intermediate points were grouped, with the junctions taking the same rates, and these have been termed Percentage Groups.

The following will serve to illustrate the manner of arriving at the rates to these various percentage groups.

Fort Wayne, Ind., is in the 90% Group. Muncie is the basing point for that group and is 798 miles from New York. Its rate then is:

798 miles x 0.0206 cents per mile =	16.44 cents
Add terminal charges..	6.00 cents
Rate from Muncie to New York..	22.44 cents

22.44 cents÷25 cents, base rate,=89.76 per cent, or using the rule for disposing of fractions, in which a fraction exceeding one-half is considered a full per cent, we have 90%, and all points in that group take a rate to New York of 90% of the Chicago-New York rate.

This placed the rates between all groups in the Central states and New York City on a strict mileage

*Measured by the shortest route "worked or workable."

basis in the beginning, but certain conditions have caused these to be altered in a few situations, as will be shown later.

Differentials

The rates between Central States points and other Atlantic sea ports than New York, were made certain differentials over or under the rate from the same points to New York.

These differentials are:

FROM Central States—EASTBOUND

TO		Deduct from Chicago-New York rate					
	Classes	1	2	3	4	5	6
Baltimore, Md.	Cents per 100 lbs.	3	3	3	3	3	3
Philadelphia, Pa.	Cents per 100 lbs.	2	2	2	2	2	2
		Add to Chicago-New York rate					
Boston, Mass.	Cents per 100 lbs.	7	6	5	4	3	2

TO Central States—WESTBOUND

FROM		Deduct from Chicago-New York rate					
	Classes	1	2	3	4	5	6
Baltimore, Md.	Cents per 100 lbs.	8	8	3	3	3	3
Philadelphia, Pa.	Cents per 100 lbs.	6	6	2	2	2	2
Boston, Mass.		Same as New York-Chicago rate					

The following table shows the mileage from Chicago to these various Atlantic sea-ports:

	Miles
Chicago to Boston	1006
" " New York**—Basing distance	920
" " Philadelphia	823
" " Baltimore	782

Note the differences between the basing distance Chicago to New York of 920 miles and the three other points:

	Miles
Chicago to Boston exceeds basing distance	86
" " Philadelphia less than basing dist.	97
" " Baltimore less than basing dstance	138

**Actual short-line distance is now 912 miles.

Multiplying these differences by the rate per 100 lbs. charged for hauling between Chicago and New York, which is 0.0206 cents per mile, we have—

Boston 86 miles x 0.0206 cents = 1.77* cents more than New York.

Philadelphia 97 Miles × 0.0206 cents = 1.998* cents less than New York.

Baltimore 138 miles × 0.0206 cents = 2.843* cents less than New York.

It will be seen that the Boston, Philadelphia and Baltimore differentials, 6th class, Eastbound, are based strictly on distance.

The differentials from Philadelphia and Baltimore to Chicago, 6th class, Westbound, are based on the distances also. The rates from Boston to Chicago Westbound are not based on the distance, the rates being the same as from New York, although the distance is 86 miles greater.

The differentials on the four lowest classes between Philadelphia and Baltimore on the one hand, and Chicago on the other, are the same both east and west bound; on the first and second classes they are between Baltimore and Chicago 3 cents east and 8 cents westbound lower than the Chicago-New York rates; between Philadelphia and Chicago 2 cents east and 6 cents westbound lower than Chicago-New York rates.

To understand these apparently arbitrary differentials, the difference in the character of traffic east and westbound and the historical development of the rates must be taken into account.**

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*The rule for disposition of fractions makes these 2-2 and 3 cents respectively.

**The rates covering the movement of this traffic are, on the whole, lower than any similar schedule of rates in the country. Only the large volume of traffic and the relatively long average haul make them possible.

Competition Between Atlantic Sea Ports

Boston, New York, Philadelphia and Baltimore, all important sea ports, became commercial rivals as transportation facilities extended further from the Atlantic Ocean. The State of New York had constructed the Erie Canal, connecting the port of New York with the Great Lakes. This lead the State of Pennsylvania to project the "State Line of Public Works" (a railroad) to connect Philadelphia with the territory west of the Allegheny Mountains. Maryland interests constructed the Baltimore and Ohio to connect Baltimore with the Ohio River.

In the earlier railroad development the main trunk lines of railroads constructed west from the Atlantic ports were (1) What is now the New York Central, built along the Hudson River and across the central part of the state from the port of New York to Buffalo; (2) What is now the Erie, constructed from the port of New York across the extreme southern part of the State to the Lakes; (3) The Pennsylvania Railroad, extending from Philadelphia to Pittsburgh; (4) the Baltimore and Ohio Railroad extending from Baltimore to Parkersburg. Boston had no independent trunk line of its own to the west, but was served by the Boston and Albany Railroad, which connected it with the New York Central at Albany.

Western Gateways

Buffalo, Pittsburgh and Parkersburg were the western termini of these main lines and from each of these points railroads radiated in all directions, extending across Ohio, Michigan, Indiana and Illinois. These in turn were crossed by the north and south railroads, constructed to connect the Great Lakes with the Ohio River.

Water transportation and favorable geographical position had, even before the days of the railroad,

made Chicago the gateway to the West and Northwest; St. Louis the gate to the West and Southwest and Cincinnati to the South. These three gateways were the natural goals of the main trunk lines first mentioned. These lines competed in carrying manufactured products and merchandise west from the rival districts they served in the east, and grain, and packing house products and raw materials from the Central States to the eastern districts and the four Atlantic sea-ports.

Ruinous Competition

The competition between these trunk lines, backed by the business interests of the communities they served, was bitter and resulted in ruinously low rates, rebating, and all of the attendant evils. Rate schedules meant little, the actual rates being chaotic.

Baltimore and Philadelphia contended for lower rates than New York and Boston on the ground of shorter distance. The necessities of commercial competition impelled the commercial interests of these two former ports to contest this position to the utmost. The conflict was carried on for many years, until in 1877, the arrangement outlined was adopted as a compromise.

Commercial Factors Affecting Differential Basis

The argument for the arrangement of differentials adopted would be about as follows:

New York was the money center of the country and had the best harbor on the Atlantic coast, which had brought to it the larger part of the import and export business of the country. If Philadelphia and Baltimore were placed on the same rate basis they could not hope to maintain their commer-

cial position, so that differential rates were with these two ports a matter of business life and death.

There was the further consideration of abstract justice in being entitled to a lower rate on account of shorter distance. As they had railroad systems of their own, whose interests were identical with commercial interests, they were in position to fight indefinitely, even to the extent of conducting the transportation at a loss.

Boston had no independent through line to the west and made the best trade the circumstances would allow. The rates westbound were the same as New York on all classes and only 2 and 3 cents higher than her other competitors on the four lowest classes. The freight rate on Classes 1 and 2 was not a controlling factor in marketing such products as the rates were but a small percentage of the value of the commodities embraced in those classes.

The eastbound shipments were practically confined to raw material or other low class commodities taking 6th class or some lower commodity rate. It was of little practical consequence to Boston therefore that its 1st class rate from Chicago eastbound was 10 cents higher than to Baltimore and 9 cents higher than to Philadelphia. On the commodities which **actually moved** in large volume eastbound, her rates were only 2 cents per 100 lbs. higher than the New York rate and 5 cents higher than the lowest rate.

Rates to Interior Eastern Points

The Grand Trunk reaches both Boston and Portland, Maine. The distance from Chicago to the latter, by this road, is less than to Boston. Points in Connecticut are less distant from Chicago than Boston. The distance from Chicago to all interior points **on main lines** in New England is less than to the Atlantic ports. On this account all of New

England is on the same rate basis that applies to Boston.*

The rates to interior points in the Eastern territory, like Albany, Rochester, Syracuse and Utica, are based on the percentage their distance bears to the Chicago-New York basing distance of 920 miles. For some points located on branch lines in eastern territory certain arbitraries are added to the rates applying to the points on the main line at which the branch lines connect.

The rates applying to Baltimore and Philadelphia are carried very considerable distances inland. For instance Altoona, Pa., takes Baltimore rates and Wilkesbarre, Pa., takes Philadelphia rates.

Arbitraries in Western Groups

In the Percentage Groups of the Central States, there are several instances where specific (instead of percentage) differences above or below the rates from another basing point are used in making rates. Many years of controversy and much expensive competition between the manufacturers and railroads interested, has resulted in making rates to the east from the Mahoning and Shenango Valleys (Youngstown District) 2 cents higher, Cleveland 3 cents higher and the Johnstown District 1½ cents lower than the rates from Pittsburgh.

Adjustment of Rates Maintained

It will be observed from this, that the rates between eastern and Central States territory are automatically raised or lowered as the basic rate between Chicago and New York is raised or lowered. In the recent advance of rates between these terri-

*On some branch lines, arbitraries are added for local haul from the junction.

tories the same relative differences in rates from different groups was maintained as had existed prior to such advance. When the 5% increase was granted by the Interstate Commerce Commission, the existing basing rate was advanced to—

100 Per Cent Rates

Classes	1	2	3	4	5	6
Rates in Cents per 100 lbs....	78.8	68.3	52.5	36.8	31.5	26.3

The rates to the other Atlantic seaboard points were made the same differentials above and below these basing rates as were in effect before and the percentage group rates were all advanced 5% automatically by advancing the base rate.

Principles Involved in Percentage and Differential Rates

The reasoning upon which these percentages rates are based may be summarized as follows:

Broadly the rates are based on mileage, modified by commercial conditions, character of traffic and competition, and also by cost of service and the application of the principle of equitable concession.

The New England States must be relieved from the strict application of a mileage basis on westbound traffic in order to market the products of their mills and factories.

On the lower classes of westbound traffic, on which the transportation charge is an important percentage of the selling value, they are only required to pay 3 cents more per 100 lbs. than their most favorably situated competitor; on the higher class traffic, on which the transportation charges are not an important part of selling value, they pay 8 cents per 100 lbs. more. They are able to force this concession because their railroads originate this business and are thus in position to influence rates.

On **eastbound** business the rates are 5 cents more on the lowest class and 10 cents more on the higher class because (1) the movement eastbound is confined largely to low class traffic and (2) as they have no through line of their own extending into origin territory, they are not in position to enforce so great a concession as on traffic in the opposite direction.

The distance from Milwaukee and the west bank Lake Michigan ports as far north as Menominee in Upper Michigan, are greater by all-rail lines than the distance from Chicago to all eastern points—265 miles in the case of the last named point or 129% of the Chicago-New York basing distance.

The rates however are the same from Menominee as from Chicago, because certain lines operate car ferries 80 miles across Lake Michigan and there is water competition as far east as Buffalo. The all-rail routes must meet the competition of Across Lake Lines and lake vessels and rates based on railroad mileage cannot, therefore, be applied to these west bank Lake Michigan points.

Rates on traffic to points on branch lines in Eastern territory are made usually by a combination of the main line rate plus the local rate from junction to destination. This gives a higher rate per ton-mile than the main line ton-mile rate figured for the entire distance. The greater cost of service on lines of light traffic, as heretofore explained, fully justifies the application of higher rates on such traffic.

Justification of Eastern Grouping

In the formation of some of the groups, particularly the Philadelphia and Baltimore groups, the Baltimore and Philadelphia rates have been carried for considerable distances inland—190 miles in the case of the Baltimore Group. As the rates to the seaboard points are based on actual distances**, it

gives higher rates per ton-mile to interior than to the Seaboard points.

Such rates are based on the principle of equitable concession in part and on lack of competition at the interior points. If the rates to Baltimore were made on a strictly mileage basis at the same rate per ton-mile as applied to the first interior point located just inside of the western boundary of the Baltimore group, the rate would be so high that competitors in Philadelphia, New York and Boston would take away the greater part of the business of Baltimore and to that extent decrease the amount of traffic carried to or from the Baltimore Group.

If the traffic were decreased, the rates at the interior point must be increased, as charges and expenses would have to be spread over a lessened traffic. That is Baltimore's commercial position would be practically destroyed and no benefit would accrue to the interior point.

So long as there is a profit in the Baltimore business at all (remembering that it is a competitive point), no injustice is done the interior point by charging it a higher rate per ton-mile, as the profit on the Baltimore business, however small, pays a part of the fixed expense and fixed charge which the interior points must pay unassisted if no Baltimore business is done.

Traffic is less able to bear the rate as distance increases, as heretofore explained, and it is equitable that the point nearer the market should bear a proportionately greater burden than traffic distant therefrom. This statement of course is made on the supposition that the rate to the interior point is reasonable **per se.**

It is, as a matter of fact, very low, being 7.7 mills

**It must be remembered that the rate per ton-mile is very low, however.

per ton-mile on sixth class traffic. As compared with rates to intermediate points in other districts than those governed by these Percentage rates, it is remarkably low. The fact that it is based on a higher rate per ton-mile than the ton-mile rate to Baltimore is not proof that it is unfair.

As to practically all of the rates in effect between Central States and Eastern Territory the long and short haul provision of the Commerce Act has not been violated.

Competition Reduces Value of Railroad Service

There is a certain traffic so circumstanced, that a portion of the value of service rendered it by a railroad is decreased on account of the availability of other systems of transportation. Evidently if a steamboat line offers a merchant in St. Louis a rate of 32 cents per 100 lbs. on a shipment to Paducah, Ky., the value of service of the railroad company is not 40 cents per 100 lbs., although it would be if no water transportation were available. But the St. Louis merchant, whatever his **ability** to pay, will pay no more than he must.

A manufacturer shipping strawboard from Lafayette, Ind., to points on the east bank of Lake Michigan will not pay the C. C. C. & St. L. Ry. a rate based on its mileage, say to Benton Harbor, when he can ship over the Chicago, Indianapolis & Louisville Railway at a rate based on a much shorter mileage.

If the Chicago, Indianapolis & Louisville Railway were not in operation, the mileage rate of the C. C. C. & St. L. Ry. would be considered fair, but the value of the service to the shipping manufacturer is no greater than the cost of shipping by the shorter route. That is, the construction of the Chicago, Indianapolis & Louisville Railway, as to certain north-

bound shipments from Lafayette, reduced the value of service of the C. C. C. & St. L. Ry. from that point.

There are two general conditions of competition which affect and prevent the application of rates based strictly on mileage or cost of service, viz: (1) On traffic between two points served by more than one road, one of which is shorter than the other—that is where one has a direct and the other a circuitous route. (2) On traffic between two points served by both railroad and water transportation in whole or in part.

Making rates for such traffic involves at times charging less for a longer than a shorter haul, when the latter is included within the former. The following discussion relates to the economic principles involved in such rates.

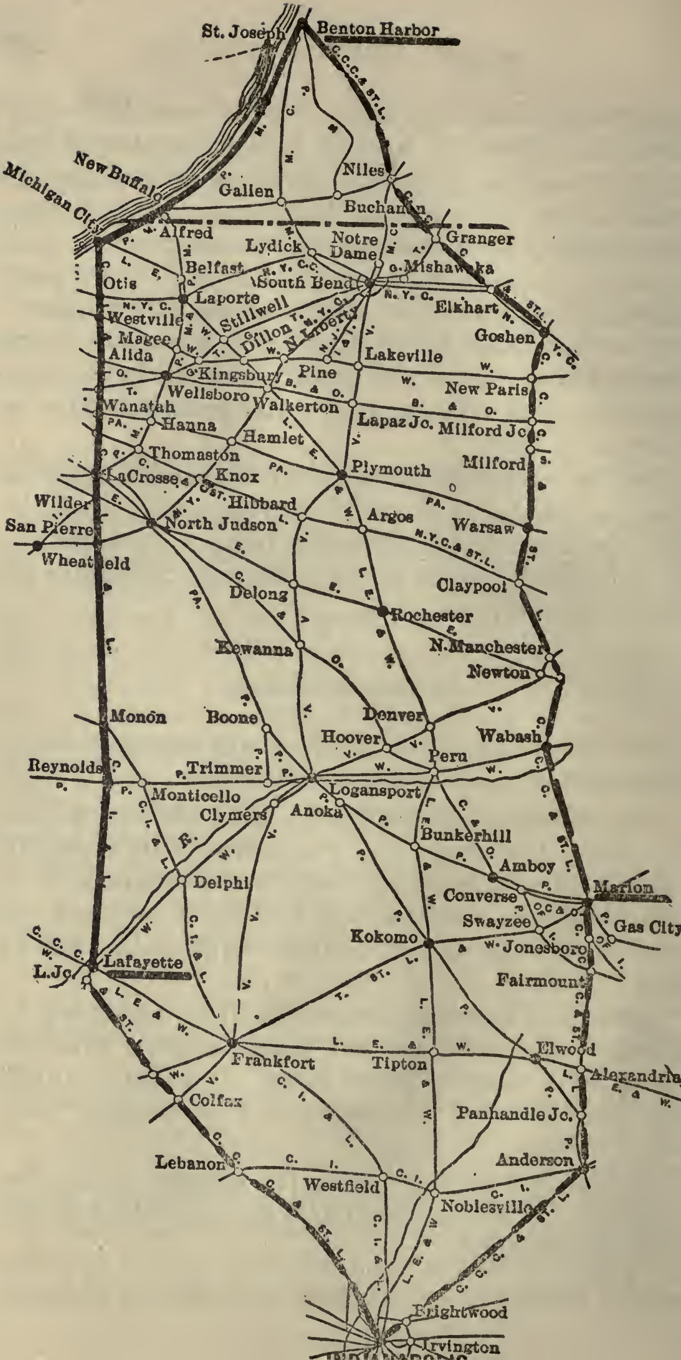
Circuitous Routes

The discussion of this subject will be aided by an illustration of an actual rate situation:

The distance from Lafayette, Ind., to Benton Harbor, Mich. (see map), by the Chicago, Indianapolis & Louisville Railway and the Pere Marquette Railroad, jointly, is 122 miles; the distance between the same two points by the C. C. C. & St. L. Ry. is 265 miles.

There is a considerable traffic from Lafayette to Michigan points in various manufactured products taking sixth class or lower rates. In order to facilitate the following discussion, the sixth class rates will be used.

The following table shows the present sixth class rates and distances from Lafayette and other points to Benton Harbor.


St. Joseph
Benton Harbor
Michigan City
Niles
Gallen
Alfred
Lydick
Notre Dame
Granger
Belfast
Mishawaka
Otis
South Bend
Laporte
Stillwell
Elkhart
Westville
Goshen
Magee
Dillon
N. Liberty
Alida
Lakeville
Kingsbury
Pine
Wellsboro
Walkerton
New Paris
Wanatah
Hanna
Lapaz Jc.
Milford Jc.
Hamlet
Thomaston
Plymouth
Milford
LaCrosse
Knox
Hibbard
Wilder
Argos
San Pierre
North Judson
Warsaw
Wheatfield
Claypool
Delong
Rochester
Kewanna
N. Manchester
Newton
Monon
Boone
Denver
Hoover
Wabash
Peru
Reynolds
Trimmer
Logansport
Monticello
Clymers
Anoka
Bunkerhill
Amboy
Delphi
Marion
Converse
Swayzee
Gas City
Kokomo
Jonesboro
Lafayette
L. Jc.
Fairmount
Frankfort
Tipton
Elwood
Alexandria
Colfax
Panhandle Jc.
Anderson
Lebanon
Westfield
Noblesville
Brightwood
Irvington

DISTANCES AND RATES TO BENTON HARBOR

FROM	Distance Miles	Rate in cts. per 100 lbs.
Lafayette via C. I. & L.-P. M.	122	8.9
Lafayette via C. C. C. & St. L.	265	8.9
Indianapolis via C. C. C. & St. L.	200	9.5
Marion via C. C. C. & St. L.	131	8.9

Traffic moved by the C. C. C. & St. L. Ry. from Lafayette to Benton Harbor passes through Indianapolis and Marion. The distance from Lafayette to Benton Harbor is 65 miles greater and the rate 0.6 cents per 100 lbs. less than the rate from Indianapolis to Benton Harbor; in fact the rate on the last 134 miles (that is after passing Marion) of the C. C. C. & St. L. up to Lafayette is greater by 0.6 cent per 100 lbs. than the Lafayette rate.

On a ton-mile basis, the rates from the several points to Benton Harbor are:

	Cents per ton-mile.
Lafayette via C. I. & L.-P. M.	1.46
Lafayette via C. C. C. & St. L.	0.67
Indianapolis	0.95
Marion	1.36

The table shows that on the same commodities, moved over the same tracks, a rate of 0.67 cents per ton-mile is charged on traffic from Lafayette to Benton Harbor moving **through** Indianapolis, while traffic originating **at** Indianapolis sent to the same destination, is charged a rate of 0.95 cents per ton-mile. Can such rates be justified?

Effect of Rates on Various Interests

There are three interests to consider: the Indianapolis shippers, the Public and the Railroad Company. A comparison of the rate from Indianapolis with those from Lafayette (by the shorter line)

and Marion shows a ton-mile rate less from Indianapolis than from the last two points, which is normal as the distance hauled is longer.

On the basis of the standard mileage scale* applying in this territory, the rates per ton-mile on sixth class traffic from these several points to Benton Harbor would be—

	Cents per ton-mile.
Lafayette via C. I. & L.-P. M.	1.46
Lafayette via C. C. C. & St. L.	0.84
Indianapolis	1.00
Marion	1.36

It will be seen from this table, that the rates from Indianapolis to Benton Harbor are 0.05 cents per ton-mile less than the **average rate** per ton-mile for this distance in this territory.

So far as the rate from Indianapolis itself is concerned, then, it seems fair by comparison and the Indianapolis shipper has no just cause for complaint.

As to the railroad company, considered as **additional business,** the traffic is moved at a profit, though much below the normal profit.** If all of its sixth class business from stations between Lafayette and Benton Harbor were hauled at rates per ton-mile as low as this rate from Lafayette to Benton Harbor, its transportation would involve a loss. Or, if the sixth class traffic between Lafayette and Benton Harbor were charged its full proportion of the fixed charges and fixed expense, on the basis of tonnage, the transaction would show a loss. As such charges and expenses are incurred whether the business is done or not, the transaction is as a matter of fact profita-

*Central Freight Association mileage scale.

**The fixed charge for interest and 34 per cent of operating expense which is fixed, will not be included in cost when the rate is to be made on the basis of out-of-pocket expense.

ble and in consequence justified from the standpoint of cost to the railroad.

It is in the interest of the public that as many different transportation routes as possible be available, for even if no reduction in rate may be obtained thereby, the service is improved by competition.

Principles Involved in Rates Over Circuitous Routes

The principles involved in the making of such rates are:

(1) When the traffic between two given points may be carried over two or more routes, the shorter route will determine the rate, and in consequence the longer route must perform its service at less revenue per ton-mile than the normal charge for its traffic as a whole.

The limiting factor in the application of this principle is, that the revenue received from the traffic must in **all** cases exceed the actual **additional cost** which its movement involves, in order that the traffic as a whole shall not bear the burden of a particular service performed at a loss.

(2) If in the application of the first principle, rates from intermediate points to the same destination are higher than from the more distant point, such a fact is not in itself proof that the rates from intermediate points are unfair.

The fairness of the rate from the intermediate points should be determined by comparison with other points similarly situated and the normal rate for the territory as a whole. If such comparison shows the rate to be fair in itself, the fact that the carrier performs a more costly service at another point for a smaller compensation, works no injustice to the intermediate point, and the carrier should not be deprived of the profit, however small, of doing the additional business, nor the terminal point of the

benefit which it obtains through such competitive service.

Water Competition

Competition between water and rail systems of transportation affects rates in certain territories very materially. The most important instances from the standpoint of volume of traffic are:

Between points on large navigable rivers, such as the Ohio and Mississippi.

Between points situated on the Great Lakes and

Between points both of which are sea ports and but the traffic between which is moved by a combination lake and rail route.

Between points both of which are sea ports and between points one of which is a sea port and the other an inland point which may be served by an all-rail route or a combination water and rail route.

So far as economic principles are concerned, they are much the same in either of these three circumstances. Illustrations of River, Lake and Ocean competitive rates will be given to show the basis and reasoning upon which they rest.

Fundamental Differences Between Rail and Water Transportation

There are certain fundamental differences in the economics of railroad and water transportation to which attention should be called before going into the discussion.

A railroad must construct a roadway, furnish equipment, maintain both of them and operate trains to move the traffic. Its rate schedule as a whole must pay the fixed charges (interest) on the cost of roadway and equipment, the cost of maintaining them and the cost of conducting the transportation.

River, Lake and Ocean lines of transportation furnish the vessel (equipment) and maintain and op-

erate it. Their rate schedules as a whole must pay interest on the cost of the vessel and cost of maintaining and operating it, and in addition wharfage or dockage for receiving and discharging freight.

Nature has furnished the roadway in greater part and the government has improved it by constructing locks and harbors and dredging shallow channels, which it also maintains at the expense of the country as a whole. That is, water-born traffic bears no burden* of interest on the cost of construction of

River Competition

The largest river traffic in this country is that carried by the Ohio and Mississippi Rivers, and cities and towns located on or near these streams usually enjoy lower transportation rates than those not so favorably situated.

Railroads connecting two points, both of which are on navigable streams, have to meet competition from water transportation as to the terminals, while to points intermediate thereto there is no such competition. The traffic between Cincinnati and other Ohio

*The tolls for the use of the Panama Canal is one exception to this general statement.

benefit which it obtains through such competitive service.

Water Competition

Competition between water and rail systems of transportation affects rates in certain territories very materially. The most important instances from the standpoint of volume of traffic are:

Between points on large navigable rivers, such as the Ohio and Mississippi.

Errata

The third paragraph under the caption "Water Competition" on page 292 should read:

Between points situated on the Great Lakes and between points neither of which are on the Lakes but the traffic between which is moved by a combination lake and rail route.

Transportation

There are certain fundamental differences in the economics of railroad and water transportation to which attention should be called before going into the discussion.

A railroad must construct a roadway, furnish equipment, maintain both of them and operate trains to move the traffic. Its rate schedule as a whole must pay the fixed charges (interest) on the cost of roadway and equipment, the cost of maintaining them and the cost of conducting the transportation.

River, Lake and Ocean lines of transportation furnish the vessel (equipment) and maintain and op-

erate it. Their rate schedules as a whole must pay interest on the cost of the vessel and cost of maintaining and operating it, and in addition wharfage or dockage for receiving and discharging freight.

Nature has furnished the roadway in greater part and the government has improved it by constructing locks and harbors and dredging shallow channels, which it also maintains at the expense of the country as a whole. That is, water-born traffic bears no burden* of interest on the cost of constructing or of operating expense in maintaining a roadway, while the railroad traffic does, and in consequence the former has an advantage in cheapness over railroad traffic.

On the other hand, the service of the railroads is superior to that of water routes in speed, safety and regularity. Ice in the rivers and lakes causes practically total suspension of water transportation during the winter months, as to the greater part of water traffic—five months in the case of the Great Lakes—and storms and accidents at sea are incident to ocean-born traffic, causing delays and affecting the safety of the transportation.

River Competition

The largest river traffic in this country is that carried by the Ohio and Mississippi Rivers, and cities and towns located on or near these streams usually enjoy lower transportation rates than those not so favorably situated.

Railroads connecting two points, both of which are on navigable streams, have to meet competition from water transportation as to the terminals, while to points intermediate thereto there is no such competition. The traffic between Cincinnati and other Ohio

*The tolls for the use of the Panama Canal is one exception to this general statement.

River Crossings and New Orleans, and other Mississippi River points is very important. The rates to intermediate points, from the Ohio River Crossings are higher than to the terminal Mississippi River points.

Rates Between St. Louis and Paducah, Ky.

The following illustration of this class of rates is given on account of its simplicity.

The Illinois Central Railroad operates a line between St. Louis on the Mississippi River and Paducah, Ky., on the Ohio River. A line of steamboats operates regularly between the same points. The distance and rates between St. Louis and several points

on the Illinois Central line are shown by the following table:

FROM St. Louis

TO	Miles	First class Rates Cents per 100 lbs.
Marion, Ill.	113	33.9
Parker, Ill.	128	35.9
Metropolis, Ill.	160	36.0
Brookport, Ill.	166	36.0
Paducah, Ky.	171	36.0

Paducah rate in effect for comparative purposes.34.0

The rate to Paducah includes a transfer charge at the Ohio River of 2 cents, which should be deducted from the actual rate in effect for the purpose of comparison with rates based on distance.

It will be seen from the table, that the charge for moving the same commodity over the same rails is practically the same for a distance of 171 miles as for a distance of 113 miles and that it is nearly 2 cents less than the rate to Parker, whose distance from St. Louis is 43 miles less.

The normal rate to Paducah, on the basis of the Illinois distance scale, plus the transfer charge at the Ohio River, would be 40.9 cents. To meet the river competition, the railroad rate has been made 12% less than the normal rate.

But the rates to the intermediate points are fair, being on the same basis as all other points in the State of Illinois where the conditions are the same. Paducah, and the other rivers points, enjoy the lower rate by reason of natural advantages, which the railroad is not called upon to adjust. On the basis of value of service, the fact that water competition is available at Paducah has reduced the value of the service rendered by the railroad at Paducah.

If the railroad were compelled to place Paducah and Marion on the basis prescribed by the Illinois distance scale, it could get none, or only a small part, of the business at Paducah, as the river rate is lower than the distance scale rate. What benefit would Marion derive from the fact that the railroad could get none of the Paducah business?

If, in order to get the Paducah business, the rates to all intermediate points between St. Louis and Paducah were reduced 12% below the rates prescribed by the Illinois distance scale (the same percentage the Paducah rate has been reduced to meet the competition), such rates would be below the normal rates of the territory and below the cost of service, which condition would force the railroad to forego the Paducah business.

The conditions are much the same as those attending that portion of the Lafayette-Benton Harbor traffic which is moved over a circuitous route, viz: that the rates to the intermediate points being fair, as compared with rates in the same territory between points similarly situated, no injustice is done the intermediate point because an equal or greater service has been performed for a terminal competitive point at a lower rate.

As to this feature of natural advantages, mentioned above, a paragraph in the decision of the Interstate Commerce Commission, in Baltimore Chamber of Commerce vs. Baltimore & Ohio Railroad—I. C. C. Reports Vol. XXII, page 603,—is interesting:

"It is not within the power of this Commission to equalize economic conditions or to place one market in a position to compete on equal terms with another market as against natural advantages. * * * The requirements of the law are, that transportation rates must be reasonable and must not be unjustly discriminatory or give undue preference."

Ohio-Mississippi River Coal Traffic

The railroads can not usually meet water competition as to certain traffic of considerable volume between points located directly on the large navigable rivers. Coal from the Pittsburgh district to all points on the Ohio and Mississippi Rivers is delivered by barge at perhaps lower costs for transportation per ton-mile than any other traffic in the world.

Immense fleets of barges are floated down during the freshets in the Ohio River, one tow-boat and crew handling as much as 25,000 tons in one fleet. The government engineers have reported the cost* of such transportation to be:

Pittsburgh to Louisville—present freshet system—empty barges returned to Pittsburgh, 0.76 **mills** per ton-mile.

Pittsburgh to New Orleans—present freshet system—empty barges not returned, but including their cost in the cost of transportation, 0.68 **mills** per ton-mile.

The estimated cost, after the completion of the improvements in the Ohio River, now under construction, which will give a minimum depth of water of nine feet, is 0.4 mills per ton-mile from Pittsburgh to both Louisville and New Orleans.

This does not mean that the railroads can not ship coal into Louisville and New Orleans, for as a matter of fact, they do so in large quantities. At the present time, on account of the shallow channel in the upper Ohio River, the coal can come from Pittsburgh only when that river is at flood heights, which occurs usually once a year and lasts for a short time only.

So far as the railroads are concerned however, their tonnage into the points located on the river is reduced by whatever tonnage the coal mines located

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*Engineering News, February 17, 1910.

on the river are able to ship by barge, and their rates per ton-mile on coal shipped to these river points, except where coal mines are located near such points, are necessarily low, in order to compete with the river-born coal carried at such low rates.

Lake Competition

A very large portion of Lake commerce consists of iron ore shipped from Minnesota and Upper Michigan to ports at the foot of Lake Michigan and on the south and east shores of Lake Erie. The vessels carrying this traffic return with coal cargoes for north and northwest territories.

The railroads, on the larger part of this traffic, obtain hauls to and from interior points to the Lakes. Practically none of it, however, is moved by rail entirely from point of origin to destination.

It is an instance of water transportation being so much cheaper than rail transportation, that the railroads can not carry the traffic in competition except at a loss, having to abandon a large traffic to a cheaper system of transportation on account of the natural advantages attached to it.

The conditions surrounding this traffic are peculiarly favorable to water transportation. The volume is very great and justifies large expenditures for plants for economically loading and unloading at points where transfer from railroad to vessel or vessel to railroad is required, and in addition the vessels are fully loaded with ore from the mines in the North and Northwest and with coal from the east for the North and Northwest, in returning.

To a limited extent, the same is true of the traffic in lumber from northern to eastern lake ports. Rates on lumber, via Lake from Ashland Bay ports (near Duluth), to Lake Erie ports, as far east as Buffalo and Tonawanda, are 7.5 cents per 100 lbs., while

the rail rate from the same ports to Buffalo is 24 cents per 100 lbs. During the season of open navigation on the Lakes, such lumber will of course move only by Lake routes.

On traffic shipped via rail and lake routes between the lake ports of Chicago, Milwaukee, Manitowoc, Wis., and Gladstone, Mich., on the one hand, and New York, on the other, the rates are lower than all-rail rates by the following amounts:

	Classes	1	2	3	4	5	6
East Bound	Cents per 100 lbs.	12	10	7	5	4	4
West Bound	Cents per 100 lbs.	13	11	9	5	5	4

Between these lake ports and the other Atlantic sea-ports the same differentials apply as in all-rail traffic. The rates to points in Illinois such as Peoria, Joliet, Streator and St. Louis, Mo., St. Paul, Duluth and Upper Michigan points, Cleveland, Detroit and Lake Erie points, are adjusted in relation to each other, the rates being made by deducting certain arbitraries from all-rail rates, as in the case between Chicago and New York stated above.

The effect of lake competition on all-rail traffic between eastern and western territories has been minimized for some years past by the fact that the railroad companies have maintained Lake lines operated in connection with their own systems of rails.

The Interstate Commerce Commission have ordered the discontinuance of this practice and it will be interesting to note what effect this will have on Rail-and-Lake rates. Inasmuch as the railroads own large dock frontage at all important lake ports, and as all frontage is fully occupied at many of them, and of the further fact that the lake carrier, for most of the traffic is between two rail carriers, it is doubtful if the enforced abandonment of lake traffic by the railroads will affect rail and lake rates radically.

Principle of Natural Advantages

The differentials allowed rail and lake traffic, below the all-rail rates, is simply a recognition of the principle that the presence of competition of cheaper transportation takes away a portion of the value of railroad service. That is, railroads in certain situations must make concessions in rates, and in some instances forego the transportation of certain traffic altogether, on account of natural conditions, just as intermediate points must pay higher freight rates than points more advantageously situated as to transportation facilities. The principle of natural advantages works both ways, "sauce for the goose is sauce for the gander."

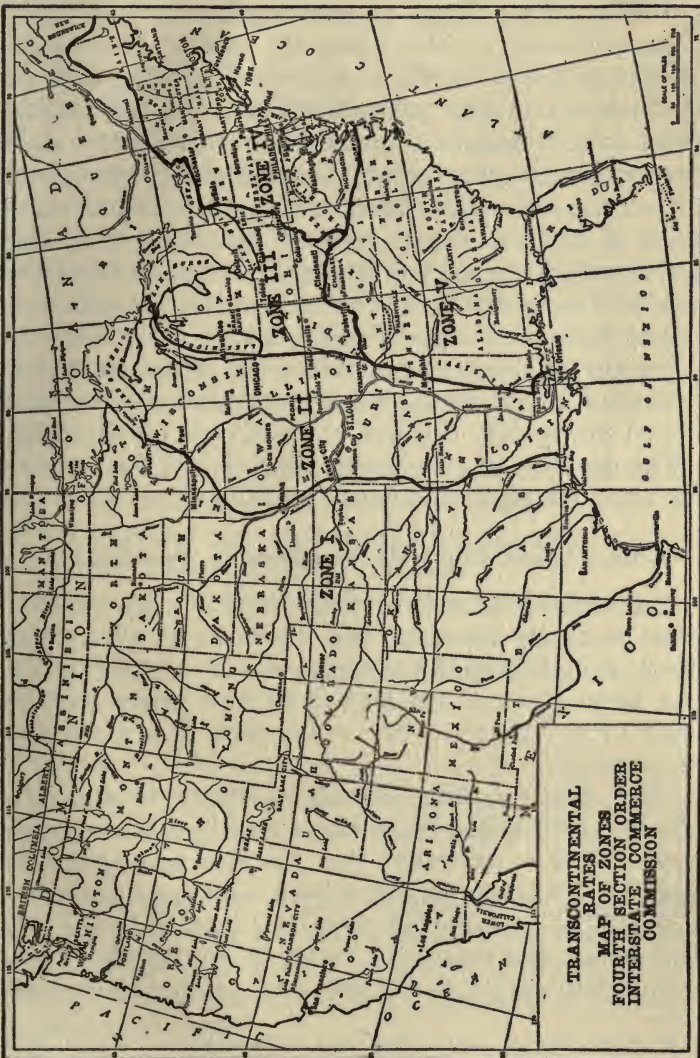
Ocean Competition

The movement of traffic between sea ports is very generally by water routes, as to the greater part of the tonnage, as it is in river and lake traffic. The traffic by ocean and rail is practically the same as that of lake and rail just described.

The traffic between the Atlantic and Pacific Seaboard is however, a very important exception, and consideration of the Trans-Continental railroad rates, in connection with the water rates, will be profitable in any discussion of rate economics, as some factors of rate making are involved which do not appear in the previous discussion.

In the following discussion, reference should be made to the maps, "Territorial Groupings for Trans-Continental Rates" and "Map of Zones" for an understanding of the text. The facts next stated are taken from Interstate Commerce Commission Reports Volume XXXII, Pages 612-658, and Volume XXI, Page 425.

Various trans-continental carriers prior to February 11, 1911, filed with the Commission applica-


TRANSCONTINENTAL
RATES
MAP OF ZONES
FOURTH SECTION ORDER
INTERSTATE COMMERCE
COMMISSION
ZONE I
ZONE II
ZONE III
ZONE IV
ZONE V

tions for relief from the Fourth Section (Long and Short Haul Section of the Commerce Act) as to rates on commodities from eastern territories to Pacific Coast terminals and intermediate points. The applications asked authority to continue the then current practice of making commodity rates to the Pacific Coast lower than to intermediate points. The carriers sought to show that all commodity rates from **all** territory of origin were influenced by the competition of water-and-rail carriers operating from the east coast of the United States by water to the Isthmus of Tehuantipec, by rail across the isthmus and thence by water to the Pacific Coast.

For the purpose of discussing the situation in disposing of these cases, the Commission divided the United States into the five zones shown on the map.

The decision of the Commission stated the reasoning upon which it was based as follows*:

Competition Must Be Reasonably Possible**

(1) "Looking at this whole situation and endeavoring to justly consider the interests of all parties affected, including the carriers, we are of the opinion that from Zone 1, no higher charge can justly be made to any intermediate point than to a more distant point.

"The eastern limit of this territory is approximately 1,500 miles from the Atlantic seaboard, almost midway between the Pacific and Atlantic oceans. No traffic has ever been, and none probably ever will be transported from this section to the Atlantic coast and thence by water to the Pacific Coast. Giving full weight to the effect of competition of all

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*I. C. C. Vol. 21. Page 425—City of Spokane vs. N. P. R. R.

**Headings are the author's.

**Blackface type used in the text shows the emphasis of the author of this book. This is to be remembered in reading quotations from opinions of the Commission.

kinds, we can find no justification for a system of rates which maintains from this territory a higher charge to any interior points than is made to the coast."

"With respect to territory embraced in Zone 2 the case stands somewhat different. This zone comprises the Mississippi Valley and a considerable portion of the great manufacturing area of the west. It lies 400 miles nearer the Atlantic seaboard, with which it is connected, in part at least, by lines of railroad affording the cheapest transportation service in any part of the country. Still there never has been and there probably never will be in the future any considerable movement of traffic from this territory to the Pacific Coast by way of the Atlantic seaboard.

"We are of the opinion that rates from this territory to intermediate points may properly exceed by not more than 7 per cent rates from the same points of origin to Pacific Coast terminals.

"From Zone 3 there is still greater possibility of actual transportation competition on business destined to Pacific Coast points, although from this section hitherto the actual movement has been only occasional.

"We are of the opinion, that from points of origin in this territory, rates to intermediate points may properly exceed those to terminal points by not more than 15 per cent.

"In the past the actual movement from eastern points of origin to Pacific coast terminals has been mainly confined to Zone 4, and even in this zone the greater part of the traffic has originated in or near the seaboard itself.

"The force of water competition is greatest at New York and gradually diminishes as the distance from New York increases, but we are of the opinion that

this entire territory may properly be treated as a single group, and that rates from points of origin within its limits to intermediate points may properly exceed those to terminal points by not more than 25 per cent.

"No opinion is expressed at this time as to Zone 5, since rates from that territory are not involved in these proceedings.

Basis of Application for Relief From Fourth Section**

The carriers in July, 1914, asked for a further hearing concerning certain commodities enumerated in a schedule (designated "C")* it being their purpose to show that "as to these rates conditions justify a greater degree of relief than is afforded under the original order."

(2) It was asserted by the petitioners:

1. "That the commodities named originate in large volume on the Atlantic Seabord.

2. "That these commodities are adapted to water transportation, and in fact move in considerable quantities from the Atlantic seaboard to the Pacific coast by water.

3. "That the rates made by the water carriers on these commodities are extremely low and necessitate correspondingly low rates by the rail carriers from eastern seaboard territory.

4. "That the low rate so imposed from the eastern seaboard to the Pacific coast necessitate correspondingly low rates from the Buffalo, Detroit, Chicago,

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**Fourth section of Commerce Act, which forbids charging more for a short haul than for a longer one—the shorter being included within the longer.

*Schedule "C" contains a list of about 2,000 items which are shown as an appendix to the decision of the commission.

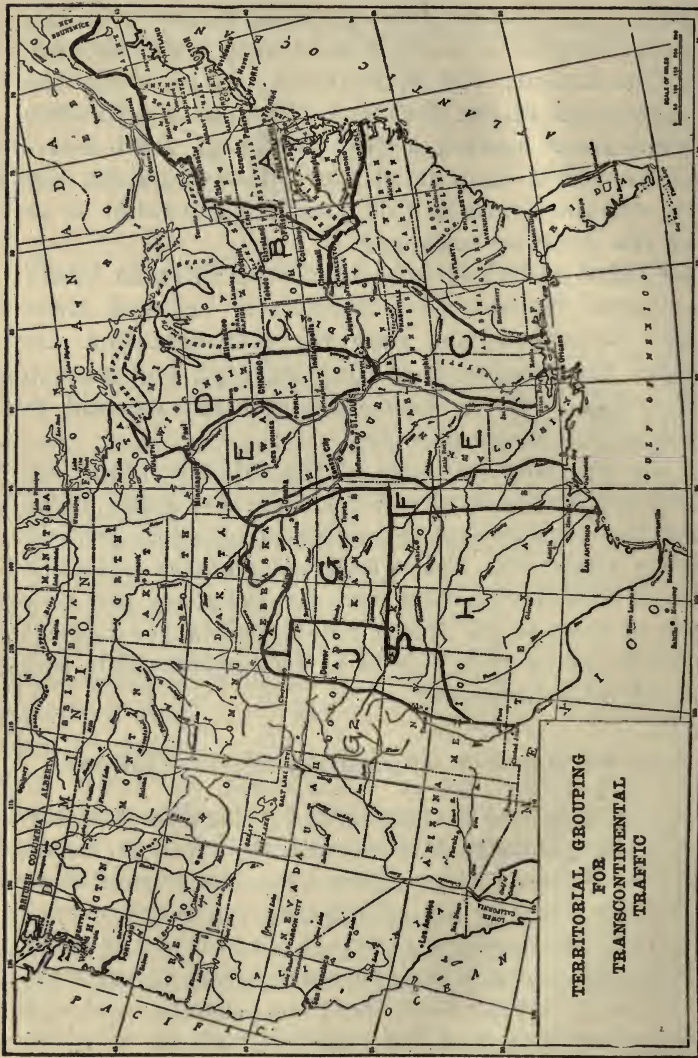
St. Louis, and Missouri River territories; (a) in order to permit the rail movement of traffic from these points to the Pacific coast in competition with the same or similar commodities moving from the Atlantic seaboard; (b) in order to comply with the requirements of the fourth section which prohibits carriers from making a greater charge from intermediate points than from more distant points, the more distant points in this case being located at or near the Atlantic seaboard.

5. "That since the opening of the Panama Canal the water carriers have materially reduced their rates, shortened the time for transportation, increased the frequency of their sailings, and materially added both to their tonnage capacity and to the actual tonnage obtained.

"The shipping interests of the intermountain territory oppose the application for further relief, some upon the ground that the relief afforded by Fourth Section Order No. 124 is sufficient; others upon the ground that the carriers have not proposed any new basis of rates to the intermediate points, the present rates to which they allege to be unreasonable and unjustly discriminatory.

Shippers Support Application of the Railroads

The application is supported by shipping interests in Chicago, Duluth, Minneapolis, St. Paul, St. Louis, and the Missouri River cities, upon the ground that, if further relief be not afforded to the carriers upon this traffic, the present policy of the carriers of maintaining rates from intermediate territory to the Pacific Coast no higher than from the Atlantic seaboard will be defeated and the business built up by these interior shipping interests with purchasers upon the Pacific Coast will be diverted to the advantage of industries near the Atlantic seaboard. * * * "



TERRITORIAL GROUPING FOR TRANSCONTINENTAL TRAFFIC

In connection with the third allegation of the carriers, the following table shows for certain commodities, sea rates prior to the opening of the Panama Canal, sea rates subsequent to such opening, the all-rail rate then in effect, the proposed all-rail rate, and the tonnage moved by sea and rail lines from Territories A and B, as shown on map "Territorial Groupings for Transcontinental Traffic."

The table shows that the proposed all-rail rate was materially higher than the ocean rate in nearly every instance, the difference being so great as to turn a large percentage of the traffic to boat lines. They could not have been materially higher from Territories A and B if the rail lines were to retain any considerable percentage of the traffic. This establishes the third allegation of the carriers.

Low Rates From Sea-board Necessitate Low Rates From Interior Points

As to the fourth allegation, that the low rates from the eastern seaboard to the Pacific Coast necessitate correspondingly low rates from Buffalo, Detroit, Chicago, St. Louis and Missouri River territories, the argument of the Commission is:

(3) "The carriers are not asking authority to make lower rates from the Atlantic seaboard than from intermediate points, for the very obvious reason that were the rates so adjusted the Pacific Coast would soon be supplying itself from the Atlantic seaboard with many of the articles which are at present shipped from the interior territory. * * *

What interest would be served by lower rates from the eastern seaboard to the Pacific Coast than from Chicago? Clearly not the carriers' interests. Any such adjustment of rates would be altogether adverse to the interests of the carriers and would almost inevitably result in their hauling much freight

Rates in Cents Per 100 Lbs.

Commodities—	Quoted sea rate prior to opening of Canal.		Quoted by Sea Routes Sept. 5, 1914.		Present Rail Rate.		Proposed Rail Rate		Tonnage from Territories A and B during year 1913.	
	L. C. L.	C. L.	L. C. L.	C. L.	L. C. L.	C. L.	L. C. L.	C. L.	Sea.	Rail.
Canned goods	85	55-60	.....	50	....	85-95	...	75	10,713	4,921
Boiler compound	90	60	.....	50	....	75	...	75	200	672
Cotton-factory sweepings	100	75	.....	75	....	110	...	95	1,457	325
Earthen and stoneware	100	100	100	100	150	95	150	..	737	5,201
Elect. goods, insulators	90	55	75-80	35-40	....	90	...	80	646	1,307
Telephone line material	90	55	80	35	....	85	...	75	217	2,859
Hardware and tools	100	100	100	100	160-190	125	150	..	14,888	5,635
Hemp	120	55	.....	55	....	75	...	75	541	24
Hose	120	85	120	85	160-175	.....	150	..	499	3,177
Iron and steel articles	75-85	45-60	75-85	30-60	....	80	...	*55-80	120,069	187,666
Ink	90	90	75	75	150	.....	125	...	1,128	206
Crowbars, chains, etc.	85	55	75-85	40-55	125-135	85	125	75	6,164	3,211
Liquors	100	100	100	60	175	.....	150	..	6,357	523
Lye	85	55	.....	40	....	75	...	75	1,079	5,637
Oilcloth, linoleum, etc.	100	60	100	60	....	110	...	75	7,061	1,243
Paint	90	65	.....	50	130	95	115	75	17,051	2,066
Paper, articles of	80-100	55-75	80-100	50-60	175-190	120-130	135	90	19,257	20,129
Pickles	65-100	50-75	.....	.....	....	100	...	100	1,862	1,580
Soap	90	50	.....	40	130	80	130	80	5,611	4,168
Twine, cordage	100	60	.....	50	....	95	...	75	5,818	762
Wire, insulated	100	50	.....	.....	....	110	...	75	7,458	2,060
Wire, fence	85-90	50-65	.....	30-40	175	90	125	75	5,802	20,638
Coal	.....	.....	.....	.....	....	42	...	..	116,819	7,384

*The 55 cent rate will not apply from Atlantic seaboard.

from the seaboard to the Pacific Coast which they now haul from intermediate points such as Chicago, a shorter distance, at a less expense.

"The same policy would result also in serious injury to many of the industries located at interior points which have, under equal rates, built up a large and profitable business on the Pacific Coast. Many articles are produced and manufactured both in the interior and on the Atlantic seaboard.

"Only a certain quantity of these manufactured articles can at present be consumed on the Pacific Coast. Any rate adjustment that tends to stimulate the movement of these articles from the Atlantic seaboard will to the same extent decrease the movement from Chicago and other intermediate points.

"It is clear that the carriers' interest, and the interests of the major part of the public served, lie in the direction of the maintenance of rates from the intermediate points no higher than from the Atlantic coast. The **intent** of the fourth section and the **aim of the Commission** in enforcing its provisions **is to reduce discriminations, not to augment them.** Discriminations of vast importance against intermediate points of origin would be created by the establishment of lower rates from the Atlantic seaboard to the Pacific coast than from intermediate points."

Grouping of Origin Territory Different for Competitive and Non-Competitive Destination Territory

"Fourth Section Order No. 124 recognized the existence of a wide blanket of rates, as to points of origin, extending from the Missouri River to the Atlantic Ocean on traffic to the Pacific Coast, while it did not provide for such blanketing of rates to points in the intermediate territory. The order has the effect of bringing about lower rates to this territory from the Missouri River and Chicago than from Pitts-

burgh and the Atlantic seaboard. * * * * *

"New York can not justly claim, that because Chicago is given the same rate as New York to the Pacific Coast, New York should be given the same rate as Chicago to the intermediate points. The claim that New York should be permitted to land freight at Salt Lake City, Reno or Phoenix at the same rate as Chicago is no more justified than the claim that New York should be permitted to land freight at Omaha, Kansas City, or Minneapolis at the same rate as Chicago."

"Upon the whole record, we are of the opinion that these carriers are justified in the maintenance of a blanket as to points of origin on rates to the Pacific Coast, and that this practice carries with it no necessity or obligation of blanketing the same territory of origin in establishing rates to intermediate points."

"This intermountain territory should be distinguished from that territory lying along the Pacific Coast, approximately 200 miles in width, to which rates from the east have been or may be arrived at by adding to the terminal rates either local rates or arbitraries proportional thereto from the terminals to the destinations."

Low Railroad Rates on Competitive Traffic Justified

(4) "As we view it, the Panama Canal is to be **one of the agencies** of transportation between the east and the west, but **not necessarily the sole carrier** of the coast-to-coast business. If the railroads are able to make such rates from the Atlantic seaboard to the Pacific Coast as will hold to their lines some portion of this traffic with profit to themselves, they should be permitted so to do.

"The acceptance of this traffic will add something to their net revenues, and to that extent decrease,

and not increase, the burden that must be borne by other traffic. It will also give the shippers at the coast points the benefits of an additional and competitive service."

"We are of the opinion that these carriers should be permitted to compete for this long-distance traffic so long as it may be secured at rates which clearly cover the out-of-pocket cost."

Low Terminal Rates Not Unjust to Intermediate Points

(5) "The fact that rates to the terminals are unusually low does not justify the maintenance of rates to intermediate points that are unreasonably high, but a lower rate to the terminal being fixed of necessity, rates to intermediate points, which are higher, do not necessarily unjustly discriminate against these points." * * * * *

(6) "Were the carriers required to observe the percentages named in the original order * * * they would be confronted with the alternative of either reducing the rates to intermediate points to a level that would result in great reductions in revenue, or continuing rates to the Pacific Coast ports which are not low enough to allow the traffic to move by the all-rail lines. In that event their choice would be governed by the relative attractiveness of the respective tonnages involved.

"The very great reductions in their revenue to intermediate points, brought about by an attempt on their part to meet the water competitive rates at the terminals, would in many instances cause their retirement from the terminal traffic and its total abandonment to the water carriers. Such a course of action **would not benefit the intermediate points of destination in the least and would result in serious injury to many intermediate points of origin."**

Competition Is Beneficial—Not to Be Diminished

"The relief afforded from the fourth section should be sufficient in each instance to permit the carriers to continue to compete for the terminal traffic so long as it may be secured at rates that are sufficient to yield a revenue in excess of operating cost.

"The maximum of public benefit from the fourth section will result from the enforcement of conditions that will tend to preserve and promote, and not to diminish or retard competition.

"Looking at the country as a whole, but more especially at the great producing and consuming areas in the interior, it is believed that what is herein proposed will best accomplish that end under prevailing conditions."

Principles Involved in Transcontinental Rates

The following principles relating to rates may be stated as the basis of the opinion of the Commission in this case:

(a) Competition must be reasonably possible, not merely theoretical, to justify the relief from the fourth section.

That the extent of the relief to be granted must be determined on the basis of possibility of actual competition—being greater at points where competition is most acute and less as circumstances tend to equalize the conditions of competition. (Quotation 1)

(b) Commerce and industries heretofore built upon existing rates are entitled to consideration in determining the fair adjustment between rates applying from competitive points of production. Rates should be at least no higher on comeptitive traffic from interior points of production, on which shorter hauls to points of destination are involved,

than rates from more distant coast points of production.

The grouping of points of origin on traffic destined to **competitive** territory carries with it no obligation to maintain the same grouping of traffic destined to **intermediate non-competitive** territory. (Quotation 3)

(c) Railroads should be allowed to reduce their rates to such an extent as will enable them to compete with other systems of transportation, if such rates exceed the out-of-pocket expense incurred in performing the service. Such a policy tends to decrease rates on other traffic, and secures to some points additional and competitive service. (Quotation 4)

(d) Low rates to competitive terminal points do not justify unreasonably high rates to intermediate points, but a low rate to a terminal, fixed by the necessities of competition, does not necessarily discriminate against the intermediate non-competitive point. (Quotation 5)

(e) To reduce rates to intermediate points of destination to the same basis as terminal points would in many instances cause the retirement of railroads from competitive terminal traffic. Such action **would not benefit the intermediate points of destination and would result in injury to many intermediate points of origin.** The maximum public benefit results from increased and not from diminished or retarded competition. (Quotation 6)

(f) In some instances discriminations are unavoidable. They are not necessarily unjust.

Principles Applicable Generally

The principles here stated apply not only to these Transcontinental rates—which are most important—but to all rate situations in which transportation

charges must be made less for performing the same service in some instances than in others. They apply in the case of traffic carried by circuitous routes and that moved in competition with other systems of transportation—in all of the so-called "long and short haul" rates.

Relation of Valuation to Rates

Many prominent railroad officials have stated at various hearings as to the fairness of existing or proposed rates, that rates bear no relation to the value or the capitalization of the property used for transportation purposes. Many prominent men in public life, writers of books and magazine articles, editors and others, have stoutly maintained that all rates should be based on a fair return on the actual physical value of the property used in performing the transportation for which the charge is made, plus the cost of performing the service.

What is the true relation between the value or capital of a railroad and its rates; between cost of service and rates?

The rate schedule, **as a whole,** should be such that the total income **shall not be less** than the cost of operating and maintaining the property and give in addition a fair return on the value of the property employed.

The valuation will not definitely fix the proper general level of rates. It will merely establish a line, below which the general level of the rates may not go—**an irreducible level,** below which rates would be confiscatory.

The rate of return on value will be greater for some roads than for others. It is not humanly possible to adjust rates in such a way that each road in the country shall earn exactly the same return on its valuation as every other road.

If the weakest road is allowed a fair return on its value, then evidently the strongest road will earn more than a bare living, for if the strongest road is allowed to earn only a bare living the weakest road will be confiscated.

This alone is the application of valuation to rates.

As to the adjustment of rates in detail between commodities or localities, the valuation is not applicable, as such adjustment must always be based on the many conditions attending any particular situation—not on any single condition or circumstance alone—as the previous discussion in this chapter clearly shows.

Relation of Cost of Service to Rates

The relation between cost of service and rates is, that the minimum rates shall be high enough **in every instance** to pay something more than the out-of-pocket expense incurred in performing the service for which the rate is charged. **Cost of service must be considered in making every rate.**

Cost of service, as applied to particular rates—like valuation as applied to the rate schedule as a whole—establishes the **irreducible minimum** below which a rate must not be made. If any commodity is carried at a rate which does not cover the cost of service, all other commodities transported are made to pay the loss thereby incurred—a burden not justly attaching to them.

Aside from this limiting feature, cost of service is **only one element of many** which are to be considered in determining rates.

Illustration—Chicago-New York Traffic

Consideration of the actual conditions which surround transportation will make this clear. As an illustration, let us consider the freight traffic be-

tween Chicago and New York. The following tabulation shows some of the characteristics of the principal lines which move this traffic:

Railroad	Distance, Miles	Number of Main Line Tracks (generally)	Traffic** Density (System average)
Pennsylvania R. R.	908	4	5.91
Pennsylvania Co.		2	4.74
Wabash	936	1	1.47
D. L. & W.		2	4.84
New York Central	978	4	3.36
L. S. & M. S.		2	3.67
Grand Trunk	983	2	2.83
Lehigh Valley		2	3.81
Erie	998	2	3.53
Chicago & Erie		2	3.93
Baltimore & Ohio	1047	2	3.18

**Traffic units, in millions, per mile of line—ton-miles plus passenger-miles.

The freight rates by all of these lines between Chicago and New York are the same. The distance, value and density of traffic and operating conditions of these several railroads vary widely. All things considered, it is probable that the New York Central or Pennsylvania can move this traffic at less cost per unit than any of the other lines, and that it will cost the Baltimore & Ohio more than any other of the lines on account of greater distance.

Suppose we attempt to base the rate between Chicago and New York on the cost of service. Shall we use the New York Central Line or the Baltimore & Ohio line as a basis? If we use the former, some of the other roads must abandon the traffic as their costs per unit would be much higher than that used in determining the rate.

The physical value per mile of line of the New York Central or Pennsylvania is the maximum, the

Wabash-D. L. & W. joint line the minimum. Which valuation is to be used?

The New York Central in part is six-track, four-track, three-track and double-track. How many of the six tracks may be properly apportioned to the Chicago-New York traffic in arriving at the value of the facilities used in carrying it?

The density of traffic is a maximum on the lines of the Pennsylvania and New York Central between the two points; it is the minimum on the Wabash and the Grand Trunk. As the cost of moving any particular traffic varies with its volume, the cost of service per unit will be higher on the Wabash and Grand Trunk than on the Pennsylvania and New York Central. Which is to be used as a basis for determining rates, the roads of maximum or minimum traffic density?

The impossibility of using valuation and cost of service in determining the fairness of rates, to any greater extent than that hereinbefore stated, is apparent whenever an attempt is made to apply them to competitive, commercial and physical conditions that actually exist.

Same Condition Applies to All Traffic

This is true not only as to those railroads connecting large centers of traffic, but applies to practically all railroad business. There are few points in this country which produce or receive considerable traffic that are not served by more than one railroad.

But even in those instances where traffic originates at points served by one road only, the **commodities** they produce compete with like commodities produced on other roads, as they are sold in competition in common markets, so that commercial factors, and not value of property employed, or cost

of service, must usually be employed in determining the rate, as in the case of direct competition between one or more railroads.

Conclusion

Rates are the resultant of many factors; cost of service, value of service, relation of cost of service to the selling price of the commodity, the nature and extent of risk of damage and loss involved, competition between railroads, between railroads and other systems of transportation, between commodities, between localities, and many other circumstances and conditions.

No public authority in this country has ever attempted to prescribe a schedule of rates based strictly on the value of the property and the cost of service. Such a rate schedule would wreck the business and industrial organization of the whole country.

RATE REGULATION

Limitation of Regulating Authority

Some fundamental facts pertaining to rate regulation have evidently not been given proper consideration by some writers discussing the subject. There is no question that regulation of the rates of a common carrier is necessary and in the interest of both the public and the railroads. On the other hand, legislative authority to prescribe rates may not be arbitrarily exercised.

It is also to be remembered that a railroad company has the title and ownership of its property to the same extent that any other property owner has and does not hold it for the use or benefit of the public in the relation of trustee to principal.

The Supreme Court of the United States has held repeatedly that, while public authority has power to regulate the use of railroad property, it is not the owner, nor has it any equity in it and, subject to the limitation that rates shall not be unjust and discriminatory, the railroads may manage their business as individuals or other non-public business corporations.

Return to Be Based on Value of Railroad Property

Railroad investments, like other investments, are subject to risk. There is no assurance of profit at the inception of the enterprise, and if badly conceived the loss is incurred by the investor. It is no more than just, then, that the investor should be rewarded in the measure which his foresight and

business judgment justifies and in proportion to the element of risk he assumes, as investors in other enterprises are. The public does not underwrite the losses of a railroad; neither can it, through legislative authority, take away the just rewards of a well-conceived enterprise.

In the Minnesota Rate Case, Justice Hughes, of the United States Supreme Court, said:*

> "It is clear that in ascertaining the present value we are not limited to the consideration of the amount of the actual investment. If this has been reckless or improvident, losses may be sustained which the community does not underwrite. As the company may not be protected in its actual investment, if the value of its property be plainly less, so the making of a just return for the use of the property involves the recognition of its fair value if it be more than its cost.
>
> "**The property is held in private ownership** and it is that property, and not the original cost of it, of which the owner may not be deprived without due process of law."

Earnings May Not Be Confiscated

In the matter of prescribing rates by public authority, in which it was contended that the prescription was merely regulation, Justice Brewer, of the United States Supreme Court, said:

> "The equal protection of the laws—the spirit of common justice—forbids that one

*Blackface type in the text shows the emphasis of the author of this book. This is to be remembered in reading quotations from other books and legal opinions.

class should by law be compelled to suffer loss that others may gain. If the state were to seek to acquire title to these roads, under its power of eminent domain, is there any doubt that constitutional provisions would require the payment to the corporation of just compensation, that compensation being **the value of the property as it stood in the markets of the world, and not as prescribed by an act of the legislature? Is it any less a departure from the obligations of justice to seek to take not the title, but the use for the public benefit at less than its market value?"**

"Property invested in railroads is as much protected from public appropriation as any other. If taken for public uses, its value must be paid for. Constitutional guarantees, to this extent, are explicit; and in such condemnation proceedings no inquiry is permitted as to how the owners have acquired the property, provided only it be legally held by them. * * * *

"These propositions in respect to condemnation proceedings are so well settled that no one ever questions them. The same general ideas must enter into and control legislation of the kind before us. The **value of the property cannot be destroyed by legislation depriving the owner of adequate compensation.**

* * * * * *

"Now, if the public was seeking to take title to the railroad by condemnation, the present value of the property, and not the cost, is that which (it) would have to pay."

These, and many other decisions of the Supreme Court of the United States make it very clear that the **earnings** of a railroad are not subject to legislative control, but that rate regulation is limited to preventing unjust and discriminatory rates. If fair and undiscriminatory rates produce large net earnings for a particular railroad, such earnings cannot be legally confiscated by legislative authority any more than the property itself.

These decisions emphasize also that the railroads are entitled to a return on the **full value** of their property—not on its cost—not on the value less the value of land grants or other public grants of aid or money, given to promote otherwise impossible enterprises. These decisions effectually dispose of the many fantastic propositions advanced from various sources, **which would have railroad property set apart and considered as something different from other property.**

Fair Return on Value

The term, fair return on value of property employed, has often been used in this and preceding chapters of this book and in all court decisions and discussions relating to railroad rates. It is a matter having a most important bearing on the subject of rates, and a statement of some conditions surrounding investments in railroad property, and their relation to a fair return on value of property employed, is essential to an understanding of the subject.

Return Can Not Be Uniform

As indicated in the illustration of the different lines moving traffic between Chicago and New York, in the chapter on rates, it is not possible to so adjust rates that there shall be a uniform return to all roads alike on value of property employed. It is

inevitable that some roads must earn a larger return on such value than others. In consequence, the fair return for any particular railroad must be determined by consideration of the conditions surrounding it.

Rate of Return Based on Security Afforded the Investment

In all lines of business, the rate of return on money invested depends on the margin of security afforded it. When this margin is wide, the return is small; when there is an element of risk, the return is larger, and the **degree of risk determines how much larger the return must be** as compared with investments in which there is practically no risk.

Government bonds of the United States pay 2½ and 3 per cent interest; City of Chicago and New York bonds pay 4 or 4½ per cent interest; smaller municipalities pay 5, 6 and 7 per cent interest. All of these bonds have a wide margin of security, as the bonds are a lien on physical property or revenue.

The net earnings on the capital and surplus of national banks for several years has averaged between 8½ and 10 per cent; many industrial corporations average from 7 to 10 per cent, and the more prosperous ones much more.

Large Element of Risk in Railroad Investment

As compared with banking or the business of the average industrial corporation, the business of the average railroad may be said to involve much more risk. When the business of banks and industries begins to shrink, railroads are the first to feel its effect. The ordinary manufacturer or business man may curtail his expenses in much greater measure during a period of depression than a railroad, as

all of its large fixed charges and rentals and at least 34 per cent of its operating expense are entirely independent of its traffic and hence of its revenue.

As to the original investors, the very large element of risk involved on account of contingencies of construction and the uncertainty of traffic estimates has been heretofore shown.** It would seem fair that the return on railroad value should be very much larger than the returns in other lines of business in which the element of risk enters to a much smaller extent.

Effect of Fair Return on Development

This is a matter which will have a very large influence on the future extensions of railroads in those portions of the country which are sparsely settled and whose development at the present time is being retarded through lack of needed transportation facilities.

There are still large areas, of great potential wealth, in the West, North-West and South-West, which cannot develop materially until they are provided with transportation. Construction in such territories will involve a repetition practically of the experience met in the earlier periods of railroad building which has been sketched in the chapters on Promotion and Construction.

The seven to ten year period following the construction of such lines will in most cases result in net losses from operation, rather than profits, with a very large probability of defaulted interest on bonds. The recent contracts between the Canadian Government and the Grand Trunk Railway emphasize the truth of this statement.

Only in exceptionally favorable situations can

**In Chapter on Promotion.

investors be interested in such enterprises unless the fairly anticipated ultimate returns shall be very much larger than from well secured conservative investments. Why should an investor take the risk involved in railroad construction and operation unless the return is large, when an investment in a solid banking or industrial enterprise promises a practically assured and equivalent return?

The need for developing railroads is not confined to the far western territory. Scattered through the Central and Southern States, in smaller areas, are local resources such as mineral and timber and isolated agricultural districts, the proper development of which requires the building of only a few miles of branch lines.

Under existing conditions the chance of raising the money to pay for the construction of such lines is not promising enough to warrant the expense of making the survey necessary to gather the data for presentation to investors. Such construction has generally been abandoned, practically none of it having been done since 1907.

In the interest of the country as a whole the development of such resources should be undertaken. Development of those here mentioned cannot proceed under existing conditions. The necessity for making investment in railroads attractive, in order to stimulate their construction, is just as essential now as it was in the earlier period of larger development.

Rate regulation, directed toward the curtailment of what by some classes has been termed the excessive profits of the most prosperous railroad systems, has resulted in a condition making it impossible to construct less promising enterprises which are necessary to normal development and growth in some wide territories and many localities.

Fair Return on the Atchison, Topeka & Santa Fe

In his testimony before the Interstate Commerce Commission, at a hearing on the proposed increase of rates in Western Territory, Mr. E. P. Ripley, President of the Atchison, Topeka & Santa Fe, testified on the subject of fair return as follows:

Question: "Do you want to make a statement as to what you think the Santa Fe should earn in order to have money to pay adequately its stockholders, to make the improvements necessary, to borrow money, to have the credit to borrow at low rates, and to serve the public to the fullest proper capacity?"

Mr. Ripley: "That, of course, is a matter of judgment. That would vary with different roads. So far as the Santa Fe is concerned, I think we ought to earn double what we pay in dividends at least. For instance, if we pay 6% in dividends, I think we ought to earn 12% on our stock, if not more; certainly not less than that."

Return to Provide for Unproductive Improvements

There is one class of railroad improvement and betterment which should be provided for under this "fair return on value" as applied to rate regulation. Passenger stations, track elevations in cities, the elimination of grade crossings where the safety of the public and operation demand it, electrification in densely populated areas when the public comfort and health require it, and other like improvements which do not in themselves add to net earnings but increase capital charges, should be considered in determining the fair return. Such improvements should, at least in part, be paid for by the present

generation, through current rates, and not be taken into the capital account to stand forever as a fixed charge against transportation.

Experience has shown that many such improvements, particularly depots, which were considered permanent improvements when constructed, have, through increased traffic and other causes, become inadequate and require the destruction of the old and construction of new facilities. Public authority and public sentiment have ample power to compel such improvements, and the rate-regulating authority should certainly recognize the necessity of providing for them without taxing the future unduly.

Not Possible to Earn Fair Return in Some Instances

There are certain railroad properties, however, which cannot expect, on account of commercial conditions, to earn a fair return on the value of their property. Many of our present terminal and belt railroads were constructed when the now large cities were much smaller and land values were only a small percentage of present values. Industrial development has enormously enhanced the value of real estate used by the railroads serving these larger cities.

If rates were fixed on the basis of producing a fair return on the value of property used, they would be so high as to decrease largely, and, as to many industries, actually stop the flow of traffic. Competition between industries would force some of them out of localities where high-priced facilities required excessive terminal charges into other localities.

Some recent valuations of properties of this class of railroads show that this condition is an actual one and not theoretical; in fact, it is encountered

in the valuation of all terminal properties at important traffic centers.

Cost of Terminals to Be Spread Over System

Where such costly terminal, belt and switching facilities belong directly to a large system, their cost may properly be spread over the whole system, as they serve the system as a whole to a large extent. The terminal charges may then be adjusted so that they will not be prohibitive. As to independently owned terminal and belt line railroads, whose cost cannot be spread over a large system mileage, the return on value of property used cannot be realized, as the rates necessary to produce it would be prohibitive commercially.

Decreased Market Price of Railroad Securities

The following statement shows the dividend payment and the quotation for the stock of several of the highest class railroad properties for a period of six years.

It will be noted that the roads shown have a comparatively high, uniform and well-sustained dividend record. The stock quotations for the whole list show an average decrease in selling price of about 25% in six years. That is, although paying generally the same rate of interest now as six years ago, these securities are only worth 75% as much now as then. They are the issues of the best managed of railroad properties, with long-sustained dividend records.

Either the buying power of money has been enhanced or this class of securities is looked upon with less favor now than formerly—that is, the return on railroad investment is not as well assured now as formerly.* The following conditions will serve

*Or other investments yield larger returns.

Dividends and Stock Quotations of Railroads*

Railroads	Dividend Record—Per Cent. 1914	'13	'12	'11	'10	'09	Stock Quotations** 1914. High	1914. Low	1913. High	1913. Low	1912. High	1912. Low	1911. High	1911. Low	1910. High	1910. Low	1909. High	1909. Low
Atchison, T. & S. F...	6	6	6	6	6	5½	100	89	106	90	112	103	117	100	124	91	125	98
Baltimore & Ohio.....	6	6	6	6	6	6	98	67	106	91	112	101	110	93	119	100	122	103
Chicago & Northw't'n.	7	7	7	..	7	7	137	122	138	123	145	134	151	138	182	137	198	173
Illinois Central	5	6	7	7	7	7	115	103	129	103	141	121	147	132	147	124	162	137
Lehigh Valley	10	10	10	10	6	6	156	118	168	141	186	156	187	151	242	125	226	134
Louisville & Nashville	7	7	7	7	7	5½	142	125	142	126	170	138	161	136	160	132	162	121
New York Central....	5	5	5	5¼	5¾	5	97	77	110	90	122	106	116	100	128	105	147	121
Norfolk & Western...	6	6	6	5¼	5	4½	106	97	114	98	119	108	111	100	109	89	102	84
Northern Pacific	7	7	7	7	7	7	118	97	123	102	132	115	138	111	146	112	160	133
Pennsylvania	6	6	6	6	6	6	115	102	124	106	126	120	130	118	138	122	151	126
Southern Pacific	6	6	6	6	6	6	99	81	110	83	116	104	126	105	138	103	139	115
Union Pacific	9	10	10	10	10	10	164	112	163	138	177	151	192	154	205	152	219	173

*From publication of Kissell, Kennicutt & Co., Brokers, Chicago.

**Fractions are omitted.

to show the basis on which this judgment of the value of railroad securities rests.

Increased Operating Expenses

For many years there has been a steady increase in railroad operating expense. The table showing the rate of compensation paid railroad employees in various periods explains in large part the increased cost of operation. The materials used by the railroads to the greatest extent, such as steel, coal, lumber, and ties, show at least no tendency toward a lower level of prices. Heavier engines and cars demand larger rail sections, and hence more tonnage per mile and a higher grade of material (Open-hearth steel at $2 per ton above Bessemer), and they therefore add something more to the increase.

Railway Employees
Classification and Wages

Class of Employees.	Increase in 10 yrs.	Average Daily Wage 1914	1913.	1912.	1911.	1904.
General officers	38%	$16.06	$15.67	$14.62	$14.82	$11.61
Other officers	7%	6.48	6.44	6.42	6.36	6.07
General office clerks	14%	2.54	2.51	2.50	2.49	2.22
Station agents	20%	2.33	2.28	2.22	2.19	1.93
Other station men	18%	1.98	1.96	1.89	1.89	1.69
Enginemen	28%	5.24	5.20	5.02	4.81	4.10
Firemen	37%	3.22	3.13	3.03	2.95	2.35
Conductors	28%	4.47	4.39	4.30	4.18	3.50
Other trainmen	36%	3.09	3.04	2.97	2.89	2.27
Machinists	25%	3.27	3.26	3.21	3.14	2.61
Carpenters	17%	2.66	2.63	2.86	2.54	2.26
Other shopmen	24%	2.36	2.31	2.24	2.24	1.91
Section foremen	24%	2.20	2.14	2.09	2.07	1.78
Other trackmen	19%	1.59	1.58	1.50	1.50	1.33
Switch tenders, crossing tenders, and watchmen	None	1.71	1.70	1.70	1.74	1.77
Telegraph operators and dispatchers	20%	2.56	2.52	2.47	2.44	2.15
Employees—Floating equipment	8%	2.35	2.37	2.37	2.34	2.17
All other employees and laborers	20%	2.20	2.15	2.10	2.08	1.82

This table shows a yearly increase in the average daily compensation of all classes of employees except switch tenders. The increases in the ten-year period are shown by percentages of the 1904 wages.

During the period between 1908 and 1915 there has been an increase in revenue per mile of railroad but such increase has not been in proportion to the increased operating expense, as the following table shows:

****Ratio of Expense to Revenue**

Years.	Operating Revenue per Mile of Line.	Operating Expense per Mile of Line.	Ratio of Expense to Revenue.
1907-8	$10,613	$7,394	69.67%
1908-9	10,486	6,933	66.12
1909-10.....	11,650	7,712	66.24
1910-11.....	11,588	7,954	68.63
1911-12.....	11,646	8,066	69.28
1912-13.....	12,746	8,842	69.40
1913-14.....	12,232	8,834	72.22
1914-15.....	11,623	8,207	70.50

**Bureau of Railway News and Statistics Leaflet, No. 32.

Decrease of Return on Invested Capital

The following statement shows the relation of Net **Earnings to Capital** employed. The effect of the increased ratio of operating expense to revenue is shown by the decreased return on capital invested—this latter being the real gauge of the financial condition of the railroads:

**Ratio of Net Earnings to Capital

Years	Net Operating Income per Mile of Line Operated	Capital per Mile Owned	Percentage of Net Earnings to Capital
1906-7	$3,547	$58,298	5.74%
1907-8	2,877	57,201	5.03
1908-9	3,188	59,259	5.38
1909-10.....	3,508	62,657	5.59
1910-11.....	3,143	63,944	4.93
1911-12.....	3,044	63,535	4.79
1912-13.....	3,384	65,851	5.15
1913-14.....	2,829	*65,500	4.32
1914-15.....	2,874	*65,850	4.36

**Bureau of Railway News and Satistics, Leaflet No. 32.
*Official figures not yet available.

This table shows that the earnings of capital invested in the year 1914-15 were only 76% of the earnings on capital in the year 1906-7. This comparison is between a year below normal and one above, but the table shows the bad financial condition generally, for a period extending over eight years.

Margin Between Profit and Loss Too Narrow

There is no question that the margin between profit and loss is much too narrow to allow the railroads to develop along normal lines, or to make their securities attractive to a discriminating investor.

A very considerable percentage of the entire railroad mileage of the country is being administered by receivers. While some of the railroad trouble has been caused by mismanagement, that reason alone will not account for the impoverished condition of railroads, which, as indicated by these tables, is

general. It applies to long-established, well-managed properties which are still out of court. Improving business will improve the present condition somewhat, but the trouble is fundamental—too narrow a margin of profit for a safe business proposition.

The net earnings of railroads must be increased if they are to be maintained in a safe, healthful business condition, capable of producing economically the service which the business of the country demands and of expanding as its business grows.

Three Possible Ways of Increasing Net Earnings

There are three ways of increasing net earnings:

(1) Increasing income by increasing rates.

(2) Decreasing operating expense.

(3) Decreasing fixed charges.

Increasing Rates

As a general proposition, increasing rates, as to a large part of the **low class traffic,** will tend to decrease traffic density and hence the unit cost of moving the traffic. The discussion in the chapter on rates shows that the enormous railroad traffic of the country has been developed by the application of very low freight rates.

Increased Rates on Particular Classes of Traffic and Certain Commodities

For this reason **radical horizontal increases** of rates are to be avoided **if the necessary increase in revenue can be obtained in a less obectionable way.** Increases of rates on **particular classes of traffic and certain commodities** which move in large volume are justified on several grounds. The following are

examples of commodities and traffic to which this statement refers.

The rates on grain, carload lots, are probably below the actual cost of service in some instances. The average receipts in the Eastern District for 1914 were 4.03 mills per ton-mile with an average haul of 350 miles. The actual revenue on **export grain** hauled over the New York Central from Chicago to New York is 2.8 mills per ton-mile, which includes the cost of handling at both terminals. The cost for hauling between terminals is very low indeed.

The average rate on bituminous coal, carloads, for the same district, is 4.15 mills per ton-mile with an **average haul of 129 miles. Some** of the coal rates must certainly be unremunerative if this is the **average** rate on so short a haul.

The rates for transportation over branch lines and main lines of secondary importance are on the same general level in some instances as the rates applying on main lines of dense traffic, although the unit cost of transportation is certainly higher.

On a proper analysis of cost, rates on **such commodities** and on such traffic as the **branch line traffic** can probably be shown to be below the cost of service in some instances and disproportionately low on all of them when value of commodity and cost of service—one or both—are considered.

The rates on live stock and packing-house products, considering the **class of transportation service** required must be very near or below cost and are certainly disproportionately low when compared with the rates on other commodities of less value. If the **relative** cost of transportation of these commodities could be shown in comparison with that of other classes, increases in rates could probably be justified. The rates on such commodities should not

be based solely on class or cost of service, but the value of the service also should have consideration.

If the investigation of cost of service recommended in the article on Importance of Cost Data in the chapter on rates is made in a thorough and exhaustive manner, an increase in the rates on such commodities, which move in large volume, could be justified before the Commissions or the Courts and should result in increased earnings of a considerable amount in the aggregate.

Decreasing Operating Expense

The railroads for the past few years—from 1907 to 1915—have practiced every possible economy in the operation and maintenance of their properties. Of the total maintenance of way expense, 66% is independent of the volume of traffic carried—repairs and replacements must be made whether many or few trains are operated.

The decreasing expenditure for maintenance of way and structures of the last few years shows that some of this operating economy has been affected by deferred maintenance that must be made good later. This is not real economy at all, but has been forced on some roads by radically decreased net earnings.

Further reductions in operating expenses cannot therefore be reasonably expected under existing conditions, the tendency being toward higher labor costs and, if not higher, certainly not lower costs for supplies required in railroad operation and maintenance.

If certain existing restrictions on railroad operation are removed there is a feasible way of reducing operating expenses somewhat.

Between all large traffic centers, as to both freight and passenger traffic, there are several competing

lines of railroads. In some instances one system has its own line extending from one to the other, and in others the through line will be operated jointly by two or more systems of railroads.

Between Chicago and New York there are four systems operating their own through lines and many joint lines, made up by the combination of two or more systems. Between Chicago and St. Paul-Minneapolis, six systems operate their own lines; between Chicago and St. Louis there are five through lines; and the same is true between all traffic centers of much less importance than these, all over the country.

Operating Economics That Might Be Effected by Unified Ownership

If the six lines operated between Chicago and St. Paul were all owned by one company, the method of operation would be different, and more economical, than under the present six managements. The Chicago, Burlington & Quincy and the Chicago, Milwaukee & St. Paul have short lines and for much the greater part of the way they have water grades. The Chicago and North Western has the shorter line but heavier, though not excessive grades.

Evidently, through freight traffic can be carried at less unit cost on the Chicago, Burlington & Quincy and the Chicago, Milwaukee & St. Paul than by the other four roads. If the **through freight traffic** were concentrated on these two lines, practically all of their through freight trains would be filled up to the capacity of the engines, and the whole through freight traffic would be hauled in fewer trains, with fewer train crews, and hence at less expense.

The same is true as to the passenger traffic. Two or three of the lines would be found able to carry the **through passenger traffic** at less cost than the

others, and such traffic would be diverted to them. There would then be two or three through lines moving through passenger trains, carrying something near their capacity, instead of five lines*, moving more trains, many of which are carrying cars partly filled, which is the present condition.

There is a further advantage in such an arrangement, in that during periods of maximum traffic movements the lines not ordinarily employed for the through traffic would be utilized to move the **surplus.** This would avoid the necessity of contructing additional tracks and other facilities which would be required if one of the lines secured more than its share of the traffic.

Pooling

All of the advantages which would accrue if the six systems were under one management may be realized if the passenger and freight traffic could be pooled. This is forbidden by law and is repugnant to present public sentiment, and yet a little consideration will show it to be in the public interest, as well as that of the railroads.

Some abuses grew out of the former money and traffic pools, and they might occur again unless such arrangements were made under proper supervision. At the time pooling was forbidden by law the Interstate Commerce Commission did not have its present power of supervision and regulation.

Nothing is clearer today than that **competition in rates between railroads is practically impossible,** and not in the interest of the public. A long-continued and expensive experience has proven to the business interests of the country that such competition is not desirable from their standpoint. **The only practicable competition is in service,** and the plan herein suggested could be made to give much

*One of the six lines does not operate through passenger trains.

better service than existing conditions admit, because equipment as well as the other facilities could be pooled.

Inasmuch as the Interstate Commerce Commission has, or can be vested with, power to regulate and supervise railroad pooling of freight and passenger business to such an extent that the old abuses may be prevented, there is no valid reason why such an arrangement as here suggested should not be made. It would reduce somewhat the otherwise necessary and substantial increases in rates and improve the service, both of which are substantial advantages for the public; it would reduce the cost of service through more economical operating conditions and utilizing more fully existing transportation facilities, both of which should enable the railroads to increase somewhat their net earnings.

It is to be understood that the pooling here suggested is not an alternative plan—a substitute for the readjustment of rates heretofore discussed. The argument is that the necessary increase of rates, **which must be made in any event,** need not be so radical if operating expense may be reduced somewhat by pooling.

Decreasing Fixed Charges

The third method of increasing net earnings is by decreasing fixed charges. The constant demand for improvements, all of which are charged to capital account, increases fixed railroad charges. The only way that such charges can be reduced, then, is to reduce the **rate** of interest paid on the funded debt of the railroads.

As already shown as to stocks and as current quotations on bonds show, the actual rate of interest under present conditions is much more likely to increase than to become less. The only remaining

way, then, of reducing the rate of interest is by increasing the security of the bonds, and public ownership of the properties is the only feasible way in which that additional security may be obtained.

The government, on its issue of bonds providing for the payment of the cost of constructing the Panama Canal, pays 3%. The entire national debt, however, exclusive of this issue is but little more than one billion dollars. If it acquired the railroads of the country, its debt would be increased by between 17 and 20 billion dollars. No country in the world at the present time owes such a debt, and it could only be conjectural to say what interest would be demanded on such a huge sum.

Government ownership of railroads does not necessarily mean government operation of them. Some such plan as that under which the subway system of rapid transit in New York City is worked is possible. The city constructs and owns the subways, the operation being conducted by an operating company leasing the property from the city.

The plan in effect lends the credit of the city in constructing the transportation facilities, but avoids the necessity of municipal operation with its many attendant evils.

The time may come when this last exedient must be adopted on economical grounds—the writer hopes most sincerely that it may never come—but as between government ownership, on the one hand, and pooling in connection with the readjustment of existing rates, on the other, the latter is certainly less objectionable.

Present conditions cannot continue indefinitely. Some expedient for increasing net earnings must be adopted within the next few years if our railroads are to be economically maintained, efficiently operated and extended to properly develop the natural resources of all parts of the country.

OUTLINE

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